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OVERCROWDING STREET CARS.

The recommendations of the New York State Railroad Commission, given in a report referring to a recent trolley car accident in Brooklyn, are worthy of attention on the part of managers of street railways. Although such recommendations have generally received but little attention in the past, owing to the limited power of the Commission, some of the present suggestions are in keeping with good management and are therefore worthy of consideration. In the case cited the motorman lost control of the car while ascending a steep grade owing to the failure of the brakes after the trolley had jumped the trolley wire. The Board, however, attaches the blame to the overcrowding of the car, and recommends that passengers be prohibited from riding on the side steps and that cars should not proceed while persons occupy the steps and refuse to either get off or stand in the aisles. The prevailing foreign practice of prohibiting the passengers to stand would never be tolerated by the public on American street railways, but there is no doubt, however, that crowding is carried to an unreasonable extent and that precautionary measures should be taken by railway managers in order to assure both their own safety and that of their patrons.

SYSTEMATIZED RECORDS.

For the successful operation of electric light and railway plants it is essential to record in a systematized manner a complete and detailed account of the various items and features having a bearing upon the income and operating expenses, and although different plants will differ considerably in the business methods employed, there are, however, certain fundamental principles to be recognized which materially affect economical management. We print in other columns of this issue an article by Mr. Githens, giving a list of "report forms" adopted by him after many trials and alterations, and which will doubtless offer valuable suggestions to managers who have not as yet employed forms for such a variety of purposes. These forms enable the manager to determine from day to day the exact operating expenses of the plant, the source of difficulty, the load at various hours, the number of customers supplied, the condition of the mains, the load and power factors and other important details. A testing department now forms a part of the best managed stations, and, as Mr. Githens says, soon repays the outlay necessitated in equipping it. The manager is thus enabled to determine for his own satisfaction the type of lamp best suited for his purpose, the reliability of meters, transformers and various instruments. To the forms which accompany the article should be added a store-keeper's report form for the purpose of giving a daily account of the amount of material consumed and on hand. All material removed from the store-room should be on a requisition blank. By keeping a strict account of all repairs and extensions, it will be possible to make a more exact estimate of the cost of desired changes. Experience has demonstrated that the labor involved in keeping such a detailed account is more than balanced by a consequent saving in numerous ways. In order to be of value, however, such forms must be used on all occasions, and kept strictly up-to-date.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The Northwestern Electrical Association has shown by the number and quality of the papers which have been presented before it, the interest taken in its proceedings, the increase in the number of its members, and the influence which it exerts, particularly in the

West, that it has attained a position among those bodies organized for the purpose of dealing with commercial electrical problems second only to that of the National Electric Light Association. An association of such prominence is therefore in a position to effectively advocate the adoption of any new measure bearing upon electrical pursuits. The desirability and necessity of having a uniform standard of light is now generally recognized by both central-station managers and manufacturers. Next to improving the existing type of lamp the problem of rating is most important. As pointed out in a communication by Mr. Marsh which recently appeared in our columns, a standard is required, which, even though empirically determined, would be approved by an authoritative body and generally accepted by lamp manufacturers. The recent report of the sub-committee on Standards of Light appointed by the American Institute of Electrical Engineers showed that valuable work had been accomplished in testing the various sources of illumination now in use, and although the committee was not in a position to suggest a new standard or one worthy of adoption, the work when completed will doubtless result in the introduction of a reliable and accurate source for comparison. At the present time some form of secondary standard accompanied by definite instructions as to its use is required. It is a consideration of this problem that deserves the attention of the Northwestern Electrical Association, and this association could perform no more important function than that of appointing a committee to act in conjunction with those appointed by the American Institute of Electrical Engineers and the National Electric Light Association for the purpose of bringing about the introduction of a more reliable source of illumination and greater uniformity in the manufacture of incandescent lamps.

AUTOMATIC MECHANICAL STOKERS.

The many recognized advantages possessed by the automatic mechanical stoker over the ordinary methods of hand firing have failed to make its adoption more general principally for the reason of its high first cost, cost of repairs and the necessary attendance required for its successful operation. In a paper read before the St. Louis meeting of the American Society of Mechanical Engineers Mr. Whitham gives the results of numerous tests on three typical types of mechanical stokers with rocking and chain grates and adapted to the use of the cheapest grades of anthracite and bituminous coals. Mr. Whitham points out that a saving of 40 per cent. can be effected in plants of 500 horse-power using mechanical stokers and provided with coal-handling machinery. Although such stokers do not develop a capacity equal to the hand-firing methods, they are more constant in the power developed and readily respond to large fluctuations in load. They may be characterized as being always in the condition of a hand fire immediately after cleaning. Such working naturally tends to a longer life of the boilers. By employing mechanical stokers, the poorest grade of coal may be used, without smoking, and at the same time with economical combustion. They, however, require power for their operation, which may be either an electric motor or small steam engine, and will cost in the case of a plant of 1000 horse-power, operating but 10 hours per day, and with fuel at $2 per ton, about $50 per year. Inasmuch as practically all stokers require a strong draught, either natural, induced or forced, this adds another item of cost to that of operating. If a steam plant be used, this will require from 5 to 11 per cent. of the total amount generated, whereas a fan blast requires from 3 to 5 per cent., which for the former amounts to $1000 per year for a plant of 1000 horse-power operating 10 hours a day, and for the latter $500, coal being considered as $2 per ton. A steam blast, when used as an aid to combustion, produces an exceedingly long flame, which results in obtaining a more uniform heating surface, and causes a more uniform expansion throughout the boiler than can be obtained by short flames, having a more or less local application. Clinkers are at the same time avoided, and the grates have a longer life. When the demand upon the boiler is not severe, it has been found preferable to shut off the steam blast when such is employed; it is at this time that care must be exercised to prevent undue heating of the grate. In stations requiring a graduated air blast still greater care is necessary to regulate the amount of air admitted. The results obtained by Mr. Whitham as shown in this paper are worthy of careful study on the part of those looking to methods of increasing the working economy of the boiler room.

Revised Telephone Tariff of Switzerland.

Hon. Eugene Germain, United States Consul at Zurich, writes to the State Department concerning telephone tariff in that country as follows:

The Swiss postal authorities on Jan. 1 last put in force a reduced telephone tariff. The former charges per annum for the use of a telephone were 80 francs ($16) with a local annual switching limit of 800. The new tariff now in force is 40 francs ($8) per annum, plus an additional charge of 5 centimes (1 cent) for each local switch. The telephone system throughout Switzerland is owned by the Government, and the service is first-class in every respect.

The switching charge to outside Swiss points, with a three-minute time limit, are as follows:

30 centimes	(6 cents)	up to	50	kilometres	(31 miles.)
50 "	(10 cents)	" "	100	"	(62 miles.)
75 "	(15 cents)	above	100	"	to very distant Swiss points.

Chemical Process of Exhausting Incandescent Lamps.

It is stated that most of the lamp manufacturers in Germany are now using chemical processes in conjunction with the air pump for exhausting incandescent lamps. A piece of amorphous red phosphorous is placed within the tube connecting the lamp with the exhaust pump. The tube is gently heated while the pump is acting, and when carried sufficiently far the current is gradually raised to about three times the normal voltage and then reversed frequently. When blue light fills the globe the tube is sealed off, so that the lamp tube still contains the phosphorous. The operation is then repeated until the blue light disappears, leaving a light-brown deposit on the glass. An experienced workman is said to perform the entire operation in about two minutes.

Honors to Prof. Hughes.

The Society of Arts has awarded the Albert medal to Prof. D. E. Hughes, in recognition of the services he has rendered to arts, manufactures and commerce by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone.

Abusing an Old Friend.

An English writer, who has doubtless had considerable valuable experience, states in a recent article that there is "no necessity for that most wasteful and abhorrent metal, mercury, which insidiously works its way into every hole and corner that it ought not, destroys or mars the appearance of adjacent instruments, and ought, as set in example by the Board of Trade laboratory, to be strictly ostracised from any self-respecting test-room."

An Old but Wise Motto.

A motto of Leonardo da Vinci, who, besides being a great painter, was a great mechanical engineer, is that "experiments never lead you astray, but it is your theories that do."

Magnetic Properties of Iron-Antimony Alloys.

Mr. Pierre Weiss, who has been making experiments on the magnetic properties of alloys of antimony and iron, has communicated some of the results of his investigations to the Societé Francaise de Physique. He finds that these alloys hold a position between the large class of feebly paramagnetic bodies and the group of iron, nickel and iron combinations, which have strong magnetic properties.

The Use of High-Voltage Lamps.

BY W. N. STEWART.

As near as can be ascertained, 220-volt incandescent lamps had been used in this country in but two central stations prior to the year 1894, viz., Allegan and Detroit, Mich.

In that year the writer entered into an extensive correspondence with several of the prominent lamp manufacturing concerns, and all attempted the production of a commercial 220-volt lamp. It is needless to say that most of the attempts were very crude, and that these lamps lacked nearly every requisite of efficiency, durability and light-giving power. But patience prevailed, as it usually does, and several of the factories are now producing an article which may be considered very near perfection,

Within the last two years central lighting stations using these lamps exclusively have been established in the following towns: Adrian, Waseca, Wells, Lake City, Windom and Preston, in Minnesota; Fort Howard, Wis.; Norwood, O.; Ontonagon, Mich., and Alta, Ia. There are several others, and some isolated plants, and many other similar installations are in contemplation.

All of these plants are situated in towns of from 2000 to 5000 inhabitants, and most of them have in use a few constant-potential arc lamps for street or commercial lighting. Dynamos were furnished by several of the large manufacturing companies, and it should be remarked that in every case they are directly connected to high-speed engines. None of the plants have a capacity of over 300 lamps of 16 candles, and most of them use only one 50 or 60-kw machine. The 220-volt system is usually recommended by local engineers for towns where distances are not prohibitive. The plants named are giving a perfectly satisfactory service, and some have been extended by the purchase of additional machinery. Many of them are operated in connection with the village water-works system, and most are owned by the municipalities.

The lamps now used have but one defect, and that is the lack of high efficiency. It is well known that lamps of low voltage use less watts per candle than lamps requiring higher E. M. F. The stock argument in favor of alternating systems of distribution used to be that lamps of 50 volts could be used; but at present one finds that lamps of 110 volts are more commonly employed. There is no logical reason why the conventional 110 volts should be adhered to beyond the force of custom, if others of higher voltage can be had of equal life and illuminating power and approximate efficiency.

Several manufacturers now produce 220-volt lamps averaging in efficiency 4 watts per candle, or 64 watts for each 16-candle lamp. We, of course, hear a great deal about 50-watt lamps of 110 volts, but they cannot be found in the average village central station. The customer will not use them because, in most cases, he pays for current at flat rates and buys his own renewal lamps. He wants a good light and few renewals, and does not care about the technical questions involved. Therefore the average lamp used in village plants consumes from 55 to 60 watts. In stations selling current by meter and furnishing free renewals, the conditions are of course reversed and if the lamp efficiency was the deciding factor, the 220-volt lamp, as at present made, would be little used.

A village central station to be successful, must, above all things, be thoroughly simple. Every complication and every danger adds to the operating expenses and repair account. Can anything simpler than a two-wire, direct-current system, operated from a single compound-wound, direct-connected dynamo be devised? Compare it with a three-wire system, using two belted, high-speed dynamos, a double set of switchboard apparatus and the illogical neutral wire. Or the alternating system, with its high-speed belted dynamo and exciter, its high-pressure primaries and multitude of transformers. If simplicity tends to lower operating expenses, certainly the advantage is with the single, direct-connected unit and its two wires without transformers.

Belting is a continual expense both in maintenance and power required to run it, small dynamos at high speed are not desirable; there are losses in neutral wires and lamp breakages owing to bad balancing, transformers leak and are peculiarly disposed to damage from lightning, while the danger to life is always present. I am therefore very well satisfied that the average village station operates at less cost when the 220-volt system is used than with any other, the less efficiency of the lamp to the contrary notwithstanding. What is lost in the lamp is gained twice over in the engine room and on the line. If this line of argument is true, applied to small plants, why should it not be true of larger installations? Let us see what it actually costs to operate those 220-volt stations.

Careful tests have been made to ascertain this important factor. In one plant, four men were under pay; 1000 incandescents and 8 arcs of 6 amperes each were connected. Fuel cost $2.50 per cord for pine slabs; the plant operated 14 hours daily, the 8 arcs and 65 incandescents of 32 candles burning all night. Eight per cent. per annum was allowed on entire cost of plant for depreciation. The total cost proved to be 4.5 cents per kilowatt-hour, which also included all cost of pumping the village supply of water, except depreciation on mains and pumping machinery. When it is remembered that reliable statistics show that the average cost of producing current in American stations of similar size is about 9.3 cents, this showing is certainly remarkable.

In other words, contractors can now guarantee a cost of 5 cents per kilowatt-hour in small stations and 4 cents in larger, provided they use good machinery and do first-class work.

The 220-volt lamps average from 1200 to 1500 hours life; the light is well diffused, and the lamps can be used with any good socket. Fuses should be long and wiring carefully done. The large station at Edinburgh is to use these lamps on a three-wire system, or 440 volts. I see no reason why the same cannot be done here, with the underwriters' consent. The efficiency of the lamps will no doubt be improved gradually, but if current is sold at 10 cents per kilowatt-hour net, and produced for 4, I fail to see any reason why both company and customer should not be satisfied. Such a simple means of extending the scope of the direct-current system is certainly worthy of the most careful investigation, and this it is of late receiving. My original idea was that the direct-connected, self-regulating dynamo deserved a larger market than that offered by isolated plants solely, and thus far my experience with its use in connection with 220-volt plants has been extremely satisfactory.

Roar of Niagara.

The following is an abstract of the report of Mr. C. R. Truex to Mr. Edward J. Hall, vice-president and general manager of the American Telephone & Telegraph Company regarding the transmission of the "Roar of Niagara" to the Electrical Exposition:

For the transmission of the roar of Niagara Falls to New York City there was set up at the Cave of the Winds on the American side of the Falls, a solid-back transmitter, encased in a wooden box through which there protruded a horn 4 feet long and 18 inches at the mount, which was screwed into the transmitter. The circuit was energized by three cells of standard Fuller battery.

The circuit between the Cave of the Winds and the Exposition Building in New York was made up as follows:

From the transmitter in the Cave of the Winds through 700 feet of two-conductor emergency cable, thence through 1000 feet of twisted pair Okonite wire, then along a metallic circuit of No. 14 iron wire, 1500 feet long, to the Niagara Falls Exchange of the Bell Telephone Company of Buffalo.

From the Niagara Falls Exchange over the trunk wires of the Bell Company to their central office in Buffalo, a distance of 22 miles, three miles of which consists of underground cable. From the Bell Company's office to the test station of the American Telephone & Telegraph Company in Buffalo, a distance of 3.5 miles.

From this point the circuit was over the standard No. 8 B. W. G. copper metallic circuit route of the American Telephone & Telegraph Company to 18 Cortlandt Street, New York City. This distance is 474.57 miles, 3.13 of which is in underground cable.

From 18 Cortlandt Street, the circuit passed through the underground system of the Metropolitan Telephone & Telegraph Company to their Thirty-eighth Street exchange, a distance of 3.74 miles. From this point, by means of one mile of underground and aerial cable to the switchboard in the exhibit of the Metropolitan Telephone & Telegraph Company, at the Exposition Building.

From this switchboard, by means of a twisted pair of wires, the circuit was led to a set of twenty police receivers placed in the centre of the exhibition hall.

The total length of this circuit is 501.92 miles, of which 11.47 is in aerial or underground cable.

The receiving telephones were connected four in series, each group being connected in multiple with the others. These instruments were placed near a working model of Niagara Falls, about 12 feet long by 4 wide.

Service was given from 8 p. m. until 10.30 p. m., daily except Sundays, during the intervals when the exposition band was not playing. Later, during the last ten days of the fair, owing to the urgent demand for an earlier exhibition of the roar of Niagara Falls, the service was given from 5 p. m. to 10.30 p. m,

On a Winding for Motor Generators.

BY P. M. HELDT.

When it is desired to transform a continuous current into an alternating current an ordinary continuous-current motor is provided with a pair of collecting rings connected to diametrically opposite points of the armature-winding, in case the machine is bipolar, or to corresponding points where the machine is multipolar.

When such a machine is attached to a continuous-current circuit of E volts, the maximum of the alternating E. M. F. between the two rings is E, and if the pole-pieces be so shaped as to give a sine form of E. M. F. curve, the virtual E. M. F. between the rings will be $\frac{E}{\sqrt{2}}$, or about seven-tenths of the continuous E. M. F. The output of such a machine is about the same as if it were driven mechanically and at the same speed.

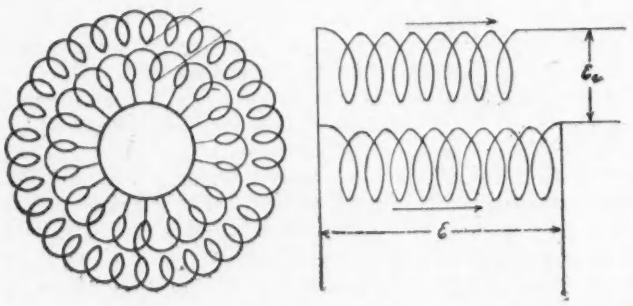
When the alternating E. M. F. must have some particular value different from $\frac{E}{\sqrt{2}}$ it is usual to provide the armature with two different windings, one for the continuous and one for the alt rnating current. Where this scheme of winding is employed any E. M. F. may be obtained by suitably proportioning the turns to each winding. It has, however, the disadvantage of reducing the permissable output by one-half, and the efficiency from n to $(2n-100)$ per cent. In what follows a winding combining the advantages of these two will be described. Although it is probably known to engineers experienced in the design of motor generators, it has never been published, as far as I am aware.

Consider a simple ring armature for a two-pole machine and provided with two collecting rings, Fig. 1. The armature is wound with two similar windings, which for convenience will be referred to as the primary and secondary. In winding the primary leads are brought out as usual for every commutator segment, while in winding the secondary only two leads are brought out, at diametrically opposite points of the armature. One of these two leads is connected to the lead of the primary winding nearest to it, while the other secondary lead and the primary lead nearest to it are connected to the collecting rings. The E. M. Fs. induced in the two windings will be in opposition. The reason for connecting the windings in opposition is that in a motor armature the current flows in opposition to the induced E. M. F., while the induced E. M. F. of the secondary, in order to raise the voltage of the current, must be in unison with it, or nearly so. In Fig. 2 the directions of the induced E. M. Fs. at some particular instant are indicated.

The number of turns to the primary winding is determined by he speed of the machine or the frequency desired. The rise in voltage required fixes the number of secondary turns. Let E be the voltage of the direct current, E_a the effective alternating voltage, and Np and Ns the number of turns to the primary and secondary respectively. Then

$$N_s = N_p \left(\frac{\sqrt{2}\, E_a - E}{E}\right)$$

It is however not necessary to have the two halves of the secondary in parallel like the primary. In a small machine for high voltage it would be advantageous to have the two halves in series,



Figs. 1 and 2.

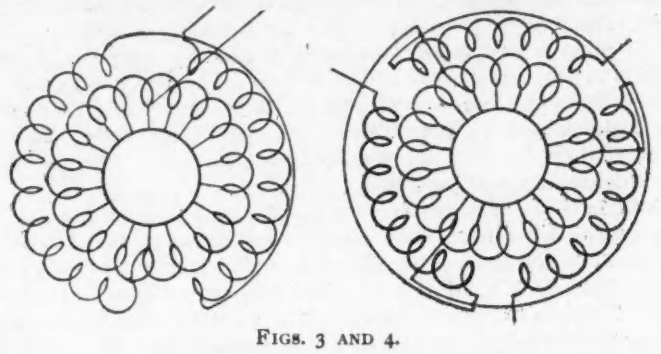
because with double the size and half the number of turns of wire the work of winding and the space taken up by the insulation would be reduced. The formula for the secondary turns now becomes

$$N_s = N_p \left(\frac{\sqrt{2}\, E_a - E}{2E}\right)$$

Fig. 3 illustrates this method of connecting the windings.

This method of winding may be equally well applied where it is desired to obtain multiphase currents from a continuous current. Fig. 4 shows a diagram of the winding for three-phase currents.

Here the secondary consists of three coils, each connected with one terminal to a point of the primary winding and with the other to one of the contact rings. Let E_a represent here the effective difference of potential between two of the secondary terminals, N_s the number of turns of one secondary coil and N_p the total primary turns. The alternating E. M. F. developed in one branch of the



Figs. 3 and 4.

primary winding is $\sqrt{\frac{3}{8}}\, E$. The E. M. F. added by the secondary winding is therefore $(E_a - \sqrt{\frac{3}{8}}\, E)$. This is the resultant of two E. M. Fs. induced in adjacent coils. They differ in phase by 120°. The components have the same value as the resultant. The maximum E. M F. induced in one of the secondary coils is $(\sqrt{2}\, E_a - \sqrt{\frac{3}{4}}\, E)$. Remembering that the primary has its two halves in parallel we find

$$N_s = N_p \left(\frac{\sqrt{2}\, E_a - \sqrt{\frac{3}{4}}\, E}{2E}\right)$$

For a two-phase machine the winding is essentially the same as for a three-phase machine. The number of turns to each of the four secondary coils is

$$N_s = N_p \left(\frac{\sqrt{2}\, E_a - E}{4E}\right)$$

Whenever the value of N_s is negative the secondary coils must be connected in the opposite way from that shown in the diagrams.

This winding is also applied to alternating continuous converters.

A similar property of alternating-current transformers was described by Mr. Miller in *Electrical Review* (London) of Nov. 15, 1895.

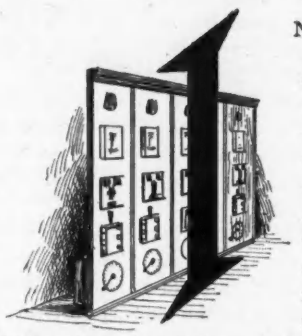
Depew-Adams Message.

Mr. Charles A. Tinker, general superintendent Western Union Telegraph Company, has submitted the following report to Mr. F. W. Hawley, chairman Committee of Arrangements, National Electrical Exposition, of the Western Union Telegraph Company's service in the transmission of the message from Mr. Chauncey M. Depew to Mr. Edward D. Adams, and Mr. Adams' reply thereto, from the Electrical Exposition, on the evening of Saturday, May 16, 1896.

Preparatory to transmission, the circuit was made up from the Exposition Building to the following points, at which automatic repeaters were introduced, viz.: Pittsburg, Pa.; Chicago, Ill.; Omaha, Neb.; Cheyenne, Wyo., Ogden, Utah; Reno, Nev.; San Francisco, Cal.; Los Angeles, Cal.; Flagstaff, Ariz.; Pueblo, Col.; Kansas City, Mo.; Chicago, Ill.; St. Louis, Mo.; Little Rock, Ark., to Galveston, Tex. Distance, 7397 miles of wire; 14 sets of repeaters.

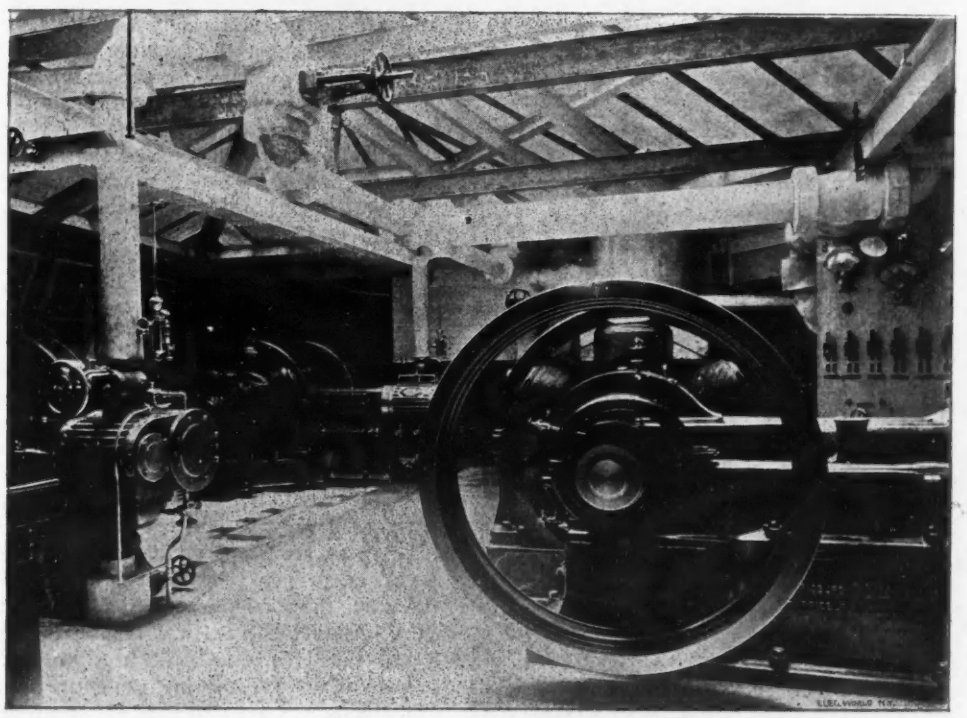
The messages were handed to Mr. Tinker by a messenger from Mr. Depew, at 8.38 o'clock, and instantly put upon the wire in direct communication with Galveston, where they were received by Col. L. C. Baker, superintendent, the transmission occupying six minutes by the official timekeeper's (Mr. Abbott) record. From Galveston it was transmitted to Buenos Ayres *via* Mexican Telegraph Company and Central and South American Telegraph Company (including land lines across the continent of South America and over the Andes from Valparaiso to Buenos Ayres) 6272 miles; *via* River Platte Telegraph Company, Buenos Ayres to Montevideo, 114 miles; *via* Western and Brazilian telegraph lines, Montevideo to Pernambuco, 2364 miles; *via* Brazilian submarine cables, Pernambuco to Lisbon, 3663 miles; *via* Eastern Telegraph Company, Lisbon to Penzance, 899 miles; *via* Western Union Telegraph Company's Atlantic cables, Penzance to Canso, 2620 miles, and at 8.59½ the messages were received over the cable wire from Canso, N. S., 1187 miles (repeaters at St. John, N. B., and Bangor, Me.), and copied upon a typewriter by Operator George W. Dickson, and delivered to Mr. Depew. The two messages contained 68 words, and were transmitted from the Exposition Building, New York, over a total distance by land lines and cables of 24,516 miles, and received back at the Exposition Building in 21½ minutes.

The 220-Volt Light and Power Plant at the New York Custom House.



IN view of the evident growing sentiment in favor of the use of 220-volt incandescent lamps, a description of the first and only plant in the East using this pressure will be of particular interest. The plant in question is that of the New York Custom House, and from all the facts obtainable, and the statements of those directly concerned in its operation, there is no room for any skepticism or doubt in regard to the successful operation of high-voltage lamps in an isolated plant. We are informed that the 220-volt Edison lamps used in this installation at least equal the 110-volt lamps in life and efficiency. This experience, however, is not based on any scientific test, but on practical observation under actual working conditions. The fact, however, is so apparent that special mention is made of it.

The plant is unique in another important respect, in that the power for the operation of the elevators is derived from units exactly similar to those used for the lighting service, the two systems being run at the same pressure—220 volts. This largely increases the flexibility of the generating plant, affording as it does entire interchangeability of the three available units. Two of these units are in constant use, one for power and the other for light, while the third is held in reserve, and applicable of course to either service. The conditions are all present for the simultaneous operation of both light and power from the same circuit, but this has not been attempted as yet.



GENERAL VIEW OF THE NEW YORK CUSTOM HOUSE GENERATING PLANT.

THE GENERATING PLANT.

The engine room occupies a triangular space in the basement, formed by the angular junction of two walls of the building and the circular rotunda wall. The floor is of white marble slabs. The plant consists of three General Electric standard, M P. 6 generators, each of 75-kw capacity, at 250 volts, running at a speed of 275 revolutions per minute. These machines are direct-connected to three 120 hp, Harrisburg Ideal, self-oiling, automatic cut off engines.

The dynamos are of the ironclad type, which type is designed especially for isolated lighting installations. The advantage possessed by this class of machine results from the use of a magnetic field circuit of cast steel of high permeability. Currents of air constantly circulate through the armature and the windings, thus affording satisfactory ventilation and a consequent reduction of heat.

The armature is of the drum type, the conductors consisting of separately insulated bars, embedded in slots on the armature core. The commutator is connected to the armature winding by flexible connections, obviating all danger from expansion and contraction of leads.

Carbon brushes are used on these machines, and a new form of brush holder provides means for carrying away the current from the carbon brushes with the least loss. The improvement consists in plugging into each brush one end of a short length of flexible conductor, the other end being placed in firm contact with the holder.

This gives a connection of least resistance between brushes and holder, and at the same time gives a freedom of action to the brushes that is not obtainable by the ordinary methods. The brush holder yokes are supported by the outboard bearings.

The smoothness of action of these combination units and the freedom of vibration are remarkable, and it would be difficult at almost any time, with one's back turned, to tell whether they were in motion or not. The engines maintain a very constant speed, thus insuring a steady light.

THE STEAM PLANT.

For some reasons this portion of the installation is regarded with considerable pride by the contractors, because some unusual difficulties presented themselves in laying out the plans for the boiler plant. They consisted chiefly of the limited amount of space available for the purpose, and the awkward shape of the same. Difficulties of this sort, however, always give way to good engineering, and this case was no exception.

The plant consists of two batteries of two horizontal tubular boilers, made by the Harrisburg Foundry & Machine Works, Harrisburg, Pa. They are set up in an annular space formed by the two circular foundation walls supporting the central dome of the building, the firing pit, which is common to both batteries, being triangular in form. Each boiler is 54 inches in diameter by 17 feet 4 inches long, and contains 56 three-inch tubes, giving a heating surface of 705 square feet, the aggregate heating surface of the four boilers being 3180 square feet. Each battery of boilers has an independent breeching and smoke flue connecting to independent smoke stacks. The boilers are piped and fitted in the most approved manner, all the feed connections being of heavy brass, the steam supply pipes being also extra heavy, with extra heavy valves, suitable for a working pressure of 150 pounds of steam.

The setting and piping of the boilers was particularly difficult, on account of the irregular shape of the space in which they were placed. This involved the necessity of establishing centre lines by transit from which to lay out the work.

The boilers are equipped with Hawley down-draft furnaces, and were built and installed according to the specifications of the government inspectors.

The auxiliary apparatus includes two Snow pumps, one 200-hp National feed-water heater and two Hancock inspirators.

The piping throughout the entire place is extra heavy, and covered with Cary's magnesia covering.

THE ELECTRICAL DISTRIBUTION SYSTEM.

The wiring of the Custom House was executed by the New York Electric Equipment Company. The building was originally wired on the three-wire system, but the specifications for the 220-volt work required that the old wiring be overhauled and done over as far as necessary to adapt it to the new service. The wire used in the entire installation is of the Grimshaw white core brand, and throughout the building the wires are run mostly on porcelain insulators. All of the risers are run in iron-armored conduits. Thirteen thousand five hundred feet of No. 14 wire were required in the installation ; 2000 feet of conduit, and 7000 feet of flexible cord.

The switchboard, which was also installed by the Equipment Company, is of Tennessee marble, and stands upon three massive

iron pedestals. It is perfectly plain, having no framework whatever, but the absence of this ornamental feature is not noticeable in this instance.

The board is equipped with 12 double-pole circuit switches, 3 double-throw 3-pole dynamo switches, 3 voltage regulators, 3 Keystone ammeters, 2 Keystone voltmeters and 1 Keystone ground detector.

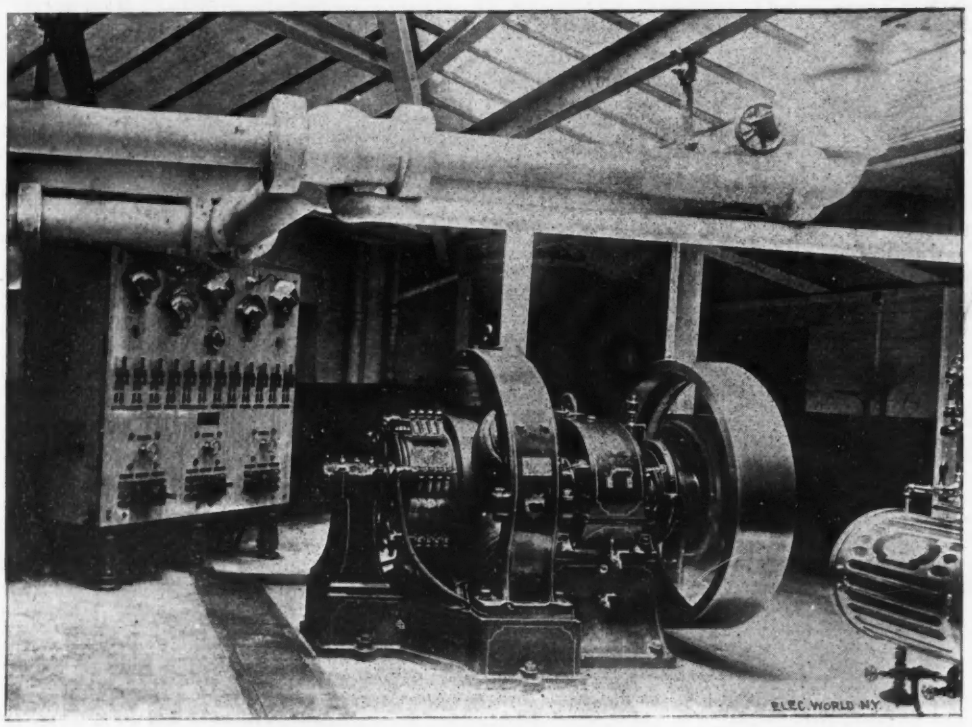
Two separate sets of bus-bars are provided at the back of the board, one for the light circuits and the other for the power (elevator) service. Each of the double-throw dynamo switches is connected on one side with the power bus-bars and on the other with the lighting bus-bars, thus permitting the use of any one of three units either for power or light service.

There are two power circuits running from the board to the two elevators, and at one end of the board is a double-throw switch, for the purpose of changing from the house to the street service; but as there is no connection with the street mains there is no present use for this switch. The house plant is shut down at night, when gas is used for lighting.

The building is wired for 1600 lights, but not more than 600 on the average are in constant use. The lights are used altogether in the daytime, because of the large number of dark rooms in the building, which in itself suggests to the stranger a dark interior and dungeon-like recesses.

STORAGE BATTERY FOR NIGHT-LIGHTING.

As above stated, the electric plant is shut down at night, and for the night light needed about the building gas is used. A contract has, however, just been closed with the Electric Storage Battery Company, of Philadelphia. for the installation of an accumulator plant for night lighting, after the generating plant has shut down.



New York Custom House Plant. The Switchboard and One of the Units.

The storage battery plant will consist of 130 cells of type E 15 chloride accumulators, having a total capacity of 72 kilowatt-hours. A motor-driven booster of four kilowatts capacity will be installed for the purpose of raising the potential sufficiently to charge the battery when the power is available, during the day service. The battery plant will supply the lights for 12 hours, and it is the intention to run the day plant from 6 a. m. to 6 p. m., and then rely on the storage battery during the other 12 hours of the 24. The accumulator plant will be installed and in running order in 30 days.

ELECTRIC ELEVATORS.

Since the elevator system depends upon the electric plant for the power for its operation, it was deemed proper in this connection to include a brief description of the electric elevators.

These machines are of the well-known Sprague-Pratt horizontal, multiple-sheave electric passenger type, manufactured by the Sprague Electric Elevator Company, New York.

Each machine has a traveling crosshead and frictionless nut driven by a 1¼-inch pitch screw revolved by an electric motor directly connected. The motor runs at 220 volts, and derives its power from one of the generating units of the electric light plant—the three units of the plant being interchangeable as regards light and power service. Any one generator can be thrown on either a power circuit or a light circuit by means of a double-throw switch on the switchboard, both classes of service being operated at the same pressure.

The electric elevators are self-contained and provided with every safeguard that experience and theory could suggest. The cars and motors are equipped with safety brakes, automatic stops, slack-cable devices, and all appliances necessary for the safe operation of the same.

The specifications for the plant were prepared by Mr. J. E. Powell, United States inspector of electric light plants in public buildings, and the contractors represented the New York Electric Equipment Company, the General Electric Company and W. R. Fleming & Co.

Electric Street Lighting.

BY M. J. FRANCISCO.

(*Continued from page 44.*)

The Jamestown plant cost $70,000; three hundred 1200-cp lamps, (moonlight schedule), operating expenses, $20,000; interest at 5 per cent., $3,500; depreciation at 5 per cent, $3,500; taxes, $1,000, total, $28,000; being $93.33 per lamp per year, using a 1200-cp lamp, only burning 2190 hours, costing .042 cents per hour and furnishing 350 candle-power for 1 cent. Last year they paved the streets and an expense of about $500 was incurred in moving the electric light poles. This was not charged to the electric light account but to the general fund, and every expense that can be is placed in the general expense account instead of placing it where it belongs, in the electric light expense. At the beginning of the year they appropriated $15,000 for operating expenses. At the end of nine months it was all used up and $5000 more had to be provided for the rest of the year. Wheeling, W. Va., was told that if the city would buy a plant the cost would not exceed $40,000, and the entire cost of running 400 arc lamps would not amount to over $14,000 per year Upon this representation they adopted municipal ownership. After the plant was installed they found that the cost was $125,000, and instead of $14,000 covering the entire cost of maintenance, the city clerk in his report, on page 4, shows that it cost $30,142 for the year, not including interest, depreciation, taxes or insurance. With these added the light cost $112.73 per lamp per year. Massachusetts has a Board of Gas and Electric Light Commissioners, and every company must report in detail the entire business of the year to this board. An examination of the report made by these commissioners, and published in January, 1896, shows that of the 62 companies in the State, 32, or more than half, could not pay a dividend, also that the surplus of these companies is $182,248 less than it was a year ago. That with the 238 towns and cities with a population of 1500 or more, only 12 in the entire State have adopted municipal ownership. We are told that light in Braintree, Mass., costs $58; in Peabody, $62. The report made to these State commissioners shows the cost of plants, operating expenses and income, also the rate of taxation on private companies. Adding interest and depreciation, we have the actual result of municipal ownership as follows:

Braintree, Mass., per Commissioner's report, January, 1896: Plant cost, $56,206.18; operating expenses, $9105.92; interest on investment at 5 per cent., $2810.30; taxes, $952; depreciation at 5 per cent., $2,810.30. Total, $15,718.52; less income, $4012.96. Grand total, $11,705.56,

Using one hundred 1200-cp lamps, only burning 7.6 hours per night, 26 nights per month, and costing $117.05 per lamp per year.

Peabody, Mass., 1896 report: Plant cost, $58,649.64; operating expenses, $10,719.49; interest on investment at 5 per cent., $2932.48; taxes, $1032.23; depreciation at 5 per cent. on $55,000, $2750. Total, $17,434.20; less income, $2949.65. Grand total, $14,484.65 Using one hundred and forty-seven 1200-cp lamps burning nine hours per night, 30 nights per month and costing $96.56 per lamp per year.

Wakefield, Mass.: Plant cost, $157,257,87; operating expenses, $9336.02; interest on investment at 5 per cent, $7862.89; taxes, $2909.37; depreciation at 5 per cent. on $10,000, $5000, $25,108.18; Less income, $3468.50; total, $21,639.68, Using one hundred and fifty 1200-cp lamps burning only 4.9 hours per night, 23 nights per month, and costing $147.27 per lamp per year. Under the laws of Massachusetts, a city is prohibited from conducting any enterprise of this kind at less than cost, and when the authorities of Wakefield found that they could not produce the light without a loss they applied to the proper State authority, and obtained permission to levy a tax to make up the deficiency.

Newburyport, Mass.: a neighboring city contracts with a private company for light at $75 per lamp per year, burning 5.7 hours per night 24 nights per month.

Among the cities that have abandoned municipal ownership after a thorough trial are: Carrollton, Ga.; Lyons, Ia.; Marceline, Mo.; Portland, Ore.; Moline, Ill.; Stockton, Kan.; Greenville, S. C.; Michigan City, Ind.; Titusville, Pa., and many others. As ex-Gov. Russell, of Massachusetts, once said: "I believe in promoting private companies and investments, and giving them the business that naturally belongs to commercial industries." Foreign cities realize that it is sound public policy to protect legitimate investment, and encourage their citizens and others to engage in public enterprises by protecting their private rights and capital. Municipal ownership is a direct thrust at private capital, and in many cases taxes the individual to raise money to destroy his own business investment. Experience has shown that it is not for the best interests of any city to attempt municipal ownership, and the losses already sustained by such ventures are enormous. Columns could be written showing examples and cases similar to those cited, but any fair-minded man can readily see that the system is a dangerous one for any city to adopt.

Municipal Ownership of Electric and Gas Plants.

BY ALLEN R. FOOTE.

(*Continued from page 43.*)

Mr. Hunter goes on to state that the cost of the lighting systems, $340,494.41 includes ground, buildings, and all apparatus pertaining to the electric lighting system.

This bureau is operated entirely independent of others, having its individual appropriation, from which all charges due to public lighting are paid, interest excepted. We add interest charges at the rate of 4 per cent. on entire investment.

Last 4 per cent. bonds sold at 106.

The cost of operating, per arc lamp, for year ending Feb. 28, 1896, was $61.246, which includes insurance and all other charges, excepting water and interest at 4 per cent. on investment; $150,994.41 for one year, and $100,000 for four months, makes interest charge per lamp $9.66.7. (Average number of lamps in service 715.) Also add 70 cents per lamp per year for water supply, makes total cost per arc lamp per annum, $71.613, divided as follows:

General operating expenses	$61.246
Interest charges	9.667
Water supply	.700
Total	$71.613

The output of station for year ending Feb. 28, 1896, was as follows:

Arc service	1,607,781.5	kilowatt hours.
Incandescent service	512,643.0	" "
Total	2,120,424.5	" "

That our city is fairly well lighted, may be determined from the following:

Area of city, seven and one half (7½) square miles; number of arc lamps, 925; number of lamps per square mile, 123.3.

Our line-wire mileage at this date is 200 miles, of which there are 171 miles of number six in arc service, and 29 miles in incandescent service.

The question of municipal ownership of electric lighting plants is one that is being agitated more or less all over the United States, and the opposition continues to ridicule the question without giving good reasons for so doing.

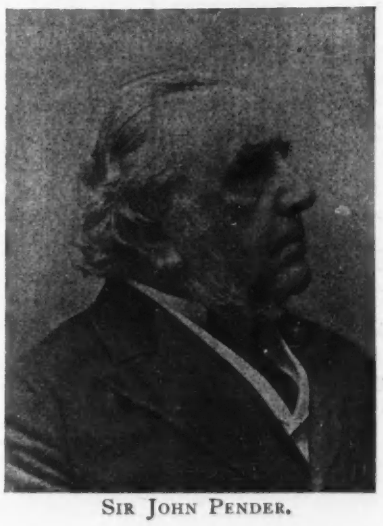
The following will show the manner of distributing the cost of items common to both arc and incandescent service. Coal being one of the items referred to we compare the output of the arc system service with the output of the incandescent service, and charge each account with their proper proportion of the cost of coal used, and so on with all other supply or repair items that cannot be separated in any other manner. Supplies for arc service only are charged to arc service; the same method refers to incandescent service. In charging the labor account, office excepted, the method above would not be correct and the following is the course pursued: In the line and lamp department the labor is charged correctly to that account of which said labor is employed, time sheets being turned into the office daily, in order that charges may be accurate. In the station or power department, for three months of the year, we charge half the cost to the incandescent and half to arc. The remaining nine months one third of the cost is charged to incandescent and the balance to arc service; the charges are made in this manner for the reason that for a period of three months the arc apparatus is in operation but eight hours daily, or one third of the station time service, while the incandescent service is continuous.

Mr. Hunter admitted that no allowance had been made for depreciation, taxes lost which would be derived from a private corporation, and that the price of coal in Allegheny is $1 per ton.

Death of Sir John Pender.

Sir John Pender, whose name is intimately associated with the history and practice of cable telegraphy, died in London on July 7, of paralysis.

John Pender was born in Dumbartonshire, Scotland, in 1816 and was educated at the high school at Glasgow, after which, in Manchester, he made the extension of submarine cable telegraphy his principal study. On the formation of the first Atlantic cable company, Sir John Pender was one of the original 345 contributors of $5000 towards the necessary expenses of the experiment. The early failures of the Atlantic cable enterprise, however, did not shake his faith in its ultimate success. It was through his efforts, combined with the support of others, that the Anglo-American Cable Company was formed, and in order to carry out its plans, Sir John gave his personal guarantee for the payment of $1,250,000 to cover the cost of the new cable. Difficulty had been experienced in securing the necessary funds on account of the previous failures in similar undertakings. The new cable, however, was successfully laid, and Sir John at once became recognized as the leader in undertakings of this character. To his energy was due the formation of the great system of the Eastern and Eastern Extension Telegraph companies. He was by nature an organizer and administrator of large enterprises, and the companies which he controlled are models of efficiency and management.



SIR JOHN PENDER.

In recognition of Sir John's services to the Empire, Queen Victoria bestowed upon him in 1888 a knighthood, and he was for nearly a quarter of a century a representative in Parliament. Sir John was decorated as an officer of the Legion of Honor by the French Government in 1891, in recognition of his services in connection with the establishment and extension of submarine telegraphy.

In recent years he has devoted much attention to the electric lighting of London, and was chairman of the Metropolitan Electric Supply Company.

Wheatstone Bridge Not Invented by Wheatstone.

It may not be generally known that Wheatstone did not invent the bridge which bears his name. The arrangement was first described by Mr. Hunter Christie at the Royal Society of England, as shown in the "Philosophical Transactions for 1833"; Wheatstone re-devised it in 1843; he himself acknowledges in his "Scientific Papers" that he did not invent it, a statement which will be found in the "Philosophical Transactions," 1843, page 303.

Central-Station Working—XVIII.

System and Forms in Central-Station Management.

BY W. L. GITHENS.

The fundamental principle of good management is "system" and system can only be maintained through the medium of comprehensive printed forms and blanks with rules governing the use of

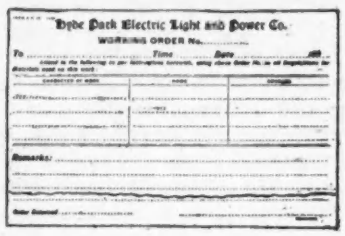


Fig. 1.—Size 6¼ x 9.

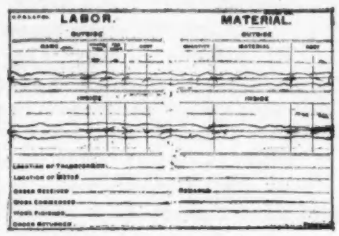
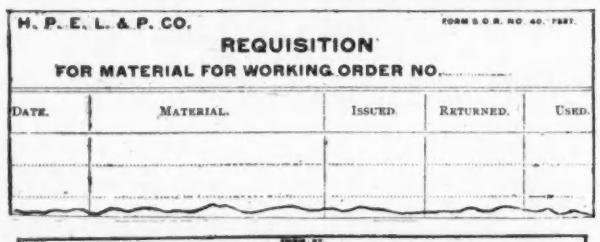


Fig. 2.—Size 6¾ x 9.

the same, covering the daily working of the station and all its connections. All these forms combined constitute the record of the business, and after having served their immediate purpose should be so filed and recorded that they may be instantly found, no matter



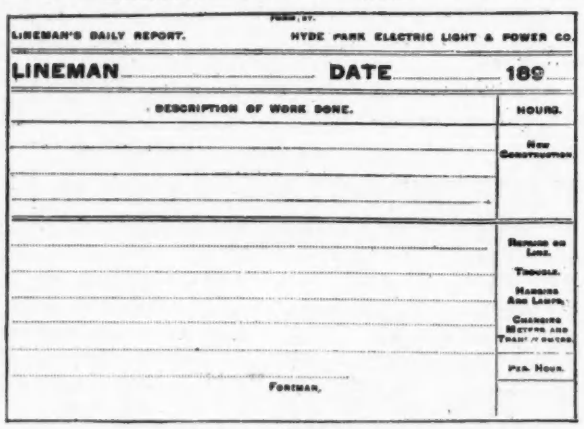


Fig. 3.—Size 5 x 3.
Fig. 4.—Size 5 x 4½.

how far back they extend, as it frequently becomes necessary to refer to them. It is only possible from the record of the business for the manager to compute the cost and selling price of his output, too often based upon the theoretical figures of others, dealing with entirely different conditions.

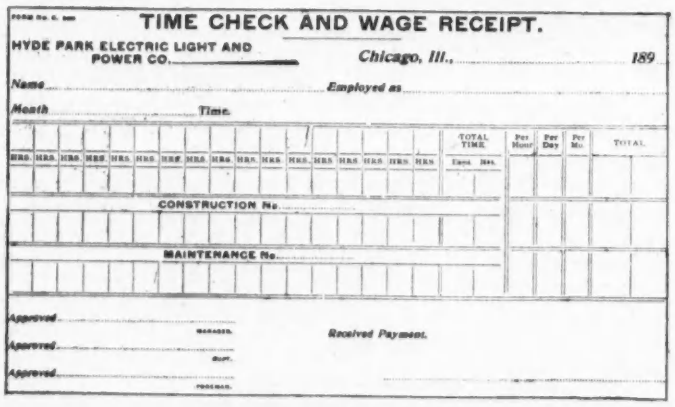


Fig. 5.—Size 7½ x 4½.

During six years as a central-station manager I have introduced and discarded many forms, some of those I now retain combining in one the good features of several discarded forms. I aim to have all my forms simple, easily understood and not conflicting.

I have one general "working order" form, Figs. 1 and 2, covering all construction, betterments and incandescent connections, excepting the installation of arc lamps, which will be described further on. This "working order" is printed in copying ink on one side, and ordinary black ink on the other. After the order is written and numbered the same as the page upon which it is to be copied, it is copied in a book just large enough for one order on a page, and then issued to the foreman, who makes out a requisition upon the storekeeper for all material needed on the "job." The "requisition," Fig. 3, having the same number as the "working

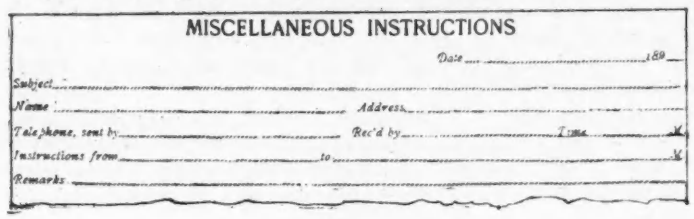


Fig. 6.—Size 7½ x 3½.

order," shows all material issued, returned and used. From the "requisition" the list of material used is copied on the back of the "working order," in column headed "material," dividing it under the heads of "outside" or "inside." Under the head of "labor," on the back of the "working order," the foreman fills in the time from the "lineman's daily report," Fig. 4, one of which is made out for each day or fraction of a day a lineman works. From these "lineman's reports" and wage list of employees working by the

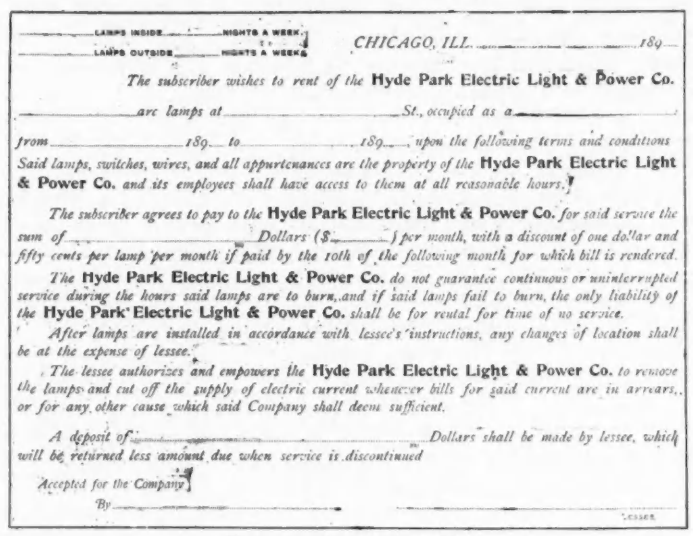

LAMPS INSIDE NIGHTS A WEEK
LAMPS OUTSIDE NIGHTS A WEEK
CHICAGO, ILL. 189
The subscriber wishes to rent of the Hyde Park Electric Light & Power Co.
arc lamps at St., occupied as a
from 189 to 189 upon the following terms and conditions
Said lamps, switches, wires, and all appurtenances are the property of the Hyde Park Electric Light & Power Co. and its employees shall have access to them at all reasonable hours.
The subscriber agrees to pay to the Hyde Park Electric Light & Power Co. for said service the sum of Dollars ($) per month, with a discount of one dollar and fifty cents per lamp per month if paid by the 10th of the following month for which bill is rendered.
The Hyde Park Electric Light & Power Co. do not guarantee continuous or uninterrupted service during the hours said lamps are to burn, and if said lamps fail to burn, the only liability of the Hyde Park Electric Light & Power Co. shall be for rental for time of no service.
After lamps are installed in accordance with lessee's instructions, any changes of location shall be at the expense of lessee.
The lessee authorizes and empowers the Hyde Park Electric Light & Power Co. to remove the lamps and cut off the supply of electric current whenever bills for said current are in arrears, or for any other cause which said Company shall deem sufficient.
A deposit of Dollars shall be made by lessee, which will be returned less amount due when service is discontinued
Accepted for the Company
By
Lessee

Fig. 7.—Size 6½ x 7½.

month are made out the "time checks and wage receipts," Fig. 5, —we pay twice a month—by the bookkeeper who separates the "construction" from the "maintenance or operation." When a "working order" is returned to the office the date is stamped upon it and a blue lead pencil line drawn through the page corresponding to it in the copying book, so that one can hastily run through the book and tell just what orders are still out. All petty orders and messages are placed on a form headed "miscellaneous instructions," Fig. 6, upon which all telephone, verbal and written messages are placed and dated, no matter how insignificant they may appear to be. I have no form as generally used, as it covers a multitude of uses. A person may telephone or write requesting information concerning arc

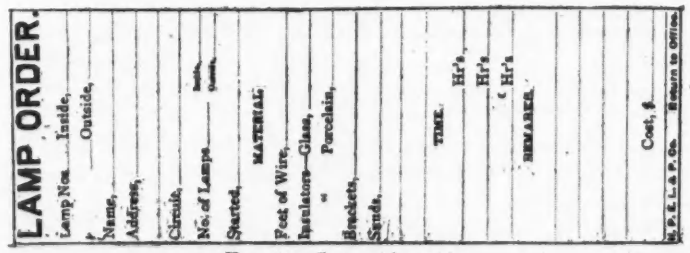


Fig. 8.—Size 2½ x 7½.

or incandescent light. The information is placed on a "miscellaneous" and given to the contract agent, who returns it to the office attached to the contract, or if no contract is made, states thereon the reason why. In many instances several of these miscellaneous forms will be attached to one contract containing a history of the transaction.

After securing an "arc contract," Fig. 7, it is sent into the office, and from it a "lamp order card," Fig. 8, made out. This "lamp order" is issued to the foreman who receipts for same on back of contract, where the dates of issue and return are also stamped. The same requisition form for securing material from stockroom is used as on "working orders," only name instead of number is used. Upon receipt of "lamp order" to office a "circuit board card" is made out, using different colored cards for seven-

TRIMMER'S DAILY REPORT.

HYDE PARK ELECTRIC LIGHT & POWER CO. Date, ... 189

NAME	ADDRESS	OUT FROM	OUT TO	NATURE OF TROUBLE.

TRIMMER.

FIG. 9.—SIZE 4 x 8.

night, six-night, and special night lamps. This card is placed on the circuit board, and shows at a glance just how many lamps are burning on each circuit. Contracts, after entering on arc light ledger, are filed under regular order number, lamp-order card number corresponding, and number entered on ledger page.

All trimmers are required to hand in a "trimmer's daily report,"

CHICAGO. 189

NOTE FOLLOWING BAD ORDER REPORTS AND MAKE REPAIRS AND CHANGES ACCORDINGLY. RETURN THIS TO OFFICE WHEN ALL O. K.

W. L. GITHENS.

NAME AND ADDRESS.	CIRCUIT.	DATE REPORTED	NATURE OF TROUBLE.

REMARKS:

FIG. 10.—SIZE 5 x 5.

(Fig. 9) upon which anything unusual is reported, also any repairs necessary to lamps or lines. All lamps reported in bad order are noted on "bad order report," Fig 10, which is delivered to chief trimmer, who remedies the trouble, noting date on the report and returns the same to the office. This date is entered in red ink on the arc ledger, by which is obtained a complete record of the working of a customer's lamp, and is valuable for reference in case of dispute.

In cutting off an arc lamp the office is notified, and same noted upon an "arc cut-off," Fig. 11, from which is made out a "cut-off" card, Fig. 12. The "arc cut-off" form is copied in a book reserved for it, and delivered with "cut-off card" to chief trimmer, who, when it is attended to, returns the card to the office, retaining the copied form for his own protection. If for any reason the lamp is left hanging it is noted in pencil on the arc ledger page, which ought to show at all times just what lamps are hanging and not in use.

Hyde Park Electric Light and Power Co.

3389 Cottage Grove Avenue.

W. L. GITHENS, MANAGER. H. A. GITHENS, SUPT.

Chicago, ... 189

MR. .....

HEREWITH FIND CUT OFF CARDS FOR THE FOLLOWING:

NAME.	ADDRESS.	No. OF LAMPS. IN	No. OF LAMPS. OUT	DATE CUT OFF.	REMARKS.

RETURN CARD TO OFFICE WITHOUT DELAY

.....

FIG. 11.—SIZE 7¾ x 5.

Application for incandescent current is made out on "current application," Fig. 13, upon which is printed the rules and rates of the company. Authority from a customer to make connection is on form, Fig. 14, which contains all necessary information from which to make out the "working order," Fig. 2. This information contains the number of lamps, where a transformer should be placed, or the location of another transformer already up to which it can be connected, etc., etc. The "working order" number is placed outside

H. P. E. L. & P. CO.

ARC--CUT OFF.

Name .....

Address .....

Date 189

No. of Lamps ..... Circt. .....

" ..... " .....

Remarks .....

Cut Off By ..... Date .....

Removed " ..... "

FIG. 12.—SIZE 3¼ x 4¼.

the "connection order" and both filed in the same order. All "working order" numbers are entered on the incandescent light ledger, which is specially ruled to meet all conditions demanded of it. All incandescent lamps for any purpose are delivered upon "incandescent lamp requisition and receipt, Fig. 16, the disposition of which are entered upon the incandescent light ledger.

My transformer board is somewhat similar to my arc circuit board,

TO HYDE PARK ELECTRIC LIGHT AND POWER COMPANY

No. ..... The Subscriber wishes to be supplied with Electric Current at the premises

No. ..... Street,

occupied as a ..... and hereby agrees to pay for the same on the terms printed on the back of this application, and to comply with the rules and regulations of the Hyde Park Electric Light and Power Company.

The subscriber agrees that the properly authorized agents of the Hyde Park Electric Light and Power Company shall at all reasonable hours have free access to said premises for the purpose of examining, repairing or removing the meter, wires and other electric appliances, and that no one who is not an agent of the Hyde Park Electric Light and Power Company shall be permitted to inspect, remove or tamper with such meter or appliances.

The subscriber further agrees to protect the meter and the wires on said premises from injury, and hereby authorizes and empowers the Hyde Park Electric Light and Power Company to remove the meter and cut off the supply of electric current whenever bills for such electric current are in arrears, or for any other cause which said Company shall deem sufficient.

It is further expressly stipulated and understood that the said Company does not guarantee a constant supply of light, and will not be liable for damages to the subscriber for failure to supply light to the above described premises.

Dated, Chicago, ... 189 .....

FIG. 13.—SIZE 8 x 3¼.

except it has square sliding buttons to cover the word "in" or "out" as the transformer happens to be. When a transformer is being put in place or changed the button is placed half way, and by referring to the "transformer record, the "working order" number can easily be ascertained.

A glance at the board will show which transformers are "in" and which are "out. A further and more complete record of all transformers is kept in the "transformer record book."

INCANDESCENT.

CHICAGO, ... 189

HYDE PARK ELECTRIC LIGHT AND POWER CO.

WIRE PREMISES, - - - - TO COST $ .....

SUPPLY ALL MATERIAL (PER OTHER SIDE) " $ .....

MAKE ALL CONNECTIONS. - - " $ .....

TOTAL, - - $ .....

TO FURNISH CURRENT TO ..... AS FOLLOWS:

CONTRACT LIGHTS.

INCANDESCENT.	ARC.
..... LPS. PER MONTH GROSS, $	..... LPS. PER MONTH, GROSS, $ .....
DISCOUNT, IF PAID BY 10TH FOLLOW'G MONTH, $	DISCOUNT, IF PAID BY 10TH FOLLOW'G MONTH, $ .....
NET, $	NET, $ .....
CURRENT TO BE FURNISHED 189	CURRENT TO BE FURNISHED 189
AND CONTINUED UNTIL 189	AND CONTINUED UNTIL 189

CONTINUOUS CURRENT NOT GUARANTEED BY HYDE PARK ELECTRIC LIGHT & POWER CO.

REMARKS .....

A DEPOSIT OF $ ..... TO BE APPLIED ON LIGHT ACCOUNT WILL BE MADE BY UNDERSIGNED TO BE RETURNED WHEN CURRENT IS DISCONTINUED, LESS AMOUNT DUE H. P. E. L. & P. CO.

ACCEPTED .....

FIG. 14.—SIZE 6½ x 8¼.

When first received all transformers are tested for iron and copper losses and regulation. The total loss in watts is entered on the "transformer record," and from it I can arrive at a fair estimate of my transformer load. Wherever there is more than one consumer

on a transformer the first name is entered in black ink, and the succeeding ones in red.

My testing room contains a complete testing apparatus for testing incandescent lamps, transformers, wattmeters and station board instruments, and its cost has been repaid to me several times over.

A half-hourly voltage reading is taken of all my arc circuits on form Fig. 15, and the results carried out in watts the following day.

A half-hourly reading im amperes is taken from my incandescent generators. I made primary station wattmeters from ordinary secondary wattmeters by running one side of my feeder through the series coil, and connecting the shunt coil to a small transformer on

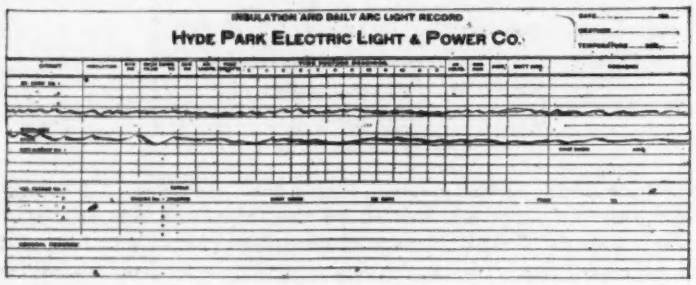


Fig. 15.—Size 17 x 10.

the same feeder; multipliers are more accurate, but with a careful test of the transformer to guide one fairly accurate watt results can be obtained.

Every pound of coal used during the 24 hours is weighed and a record kept of it. With a water meter on each boiler I know each morning what it cost to run the preceding 24 hours.

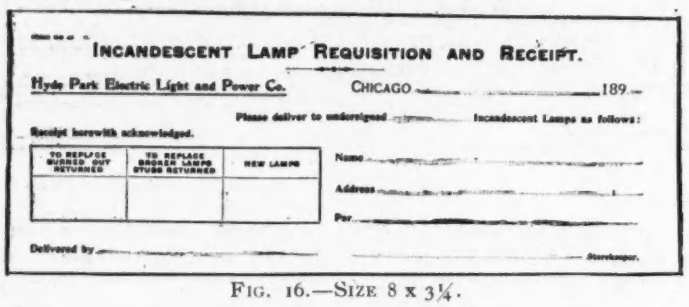


Fig. 16.—Size 8 x 3¼.

I do not consider that the keeping of any record in any way interferes with the other duties of my employees, and whatever it may cost it is saved several times over during the year.

Everything used around the station is entered on a "station requisition." All bills are checked up from a "material received" handed in by the stockkeeper.

All bills are vouchered under their regular number and charged up

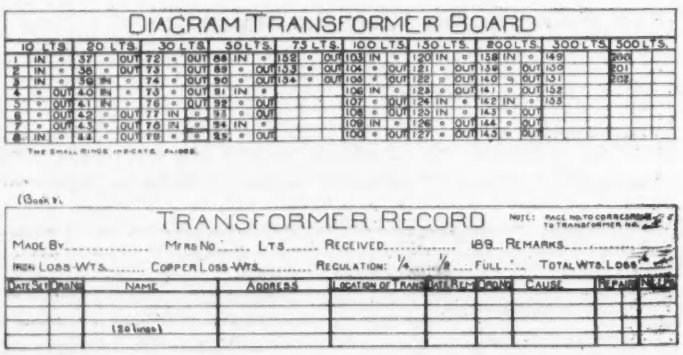


DIAGRAM TRANSFORMER BOARD

10 LTS.			20 LTS.			30 LTS.			50 LTS.			75 LTS.			100 LTS.			150 LTS.			200 LTS.			300 LTS.			500 LTS.		
1	IN	○	37	○	OUT	72	○	OUT	68	IN	○	152	○	OUT	103	IN	○	120	IN	○	138	IN	○	149				200		
2	IN	○	38	○	OUT	73	○	OUT	69	○	OUT	153	○	OUT	104	○	OUT	121	○	OUT	139	○	OUT	150				201		
3	IN	○	39	IN	○	74	○	OUT	90	○	OUT	134	○	OUT	105	○	OUT	122	○	OUT	140	○	OUT	151				202		
4	○	OUT	40	IN	○	75	○	OUT	91	IN	○				106	IN	○	123	○	OUT	141	○	OUT	152						
5	○	OUT	41	IN	○	76	○	OUT	92	○	OUT				107	○	OUT	124	IN	○	142	IN	○	153						
6	○	OUT	42	○	OUT	77	IN	○	93	○	OUT				108	○	OUT	125	IN	○	143	○	OUT							
7	○	OUT	43	○	OUT	78	IN	○	94	IN	○				109	IN	○	126	○	OUT	144	○	OUT							
8	IN	○	44	○	OUT	79	○	○	95	○	OUT				100	○	OUT	127	○	OUT	145	○	OUT							

THE SMALL RINGS INDICATE PHASES.

(Back.)

TRANSFORMER RECORD NOTE: PAGE NO. TO CORRESPOND TO TRANSFORMER NO.

MADE BY..... MFRS NO..... LTS..... RECEIVED..... 189.. REMARKS.....

IRON LOSS-WTS..... COPPER LOSS-WTS..... REGULATION: ¼..... ½..... FULL..... TOTAL WTS. LOSS.....

DATE SENT	ORDER	NAME	ADDRESS	LOCATION OF TRANS	DATE RET'D	CREDIT	CAUSE	REPAIRS	NEW TR.
		(20 lines)							

Figs. 17 and 18.—Size 8 x 12.

to either construction, betterments or operating expenses, and our books always show up to date just how much has been spent under each head.

All light ledger accounts not collected within 30 days after due are charged off to uncollected account ledger upon which full account of cost of collection is kept.

Effect of Temperature on Insulating Materials.

In the article under the above heading, which appeared in The Electrical World, May 30, 1896, page 642, Fig. 2 should be Fig. 3. "Japanned Red Paper," Fig. 3, should be Fig. 4, "Plain Cotton Duck; Fig. 4 should be Fig 2, "Plain Red Paper."

The Transformation of the Energy of Carbon Into Other Available Forms.

BY C. J. REED.

(*Continued from page 44.*)

The separation of an atom of carbon from two atoms of oxygen, or the reaction

$$CO_2 = C + O_2$$

requires as definite a quantity of energy as does the separation of a pound of rock to a distance 100 feet further from the earth's centre. The only difference between the two cases is that one is a molar, the other a molecular separation. In the one case there is a separation of visible masses, in the other a separation of invisible molecules. In either case, the potential energy acquired is equal to the work done in effecting the separation.

The molecular separation in one pound of free carbon is equal to the molar separation of raising one ton to a height of one mile. This comparison gives a very fair idea of the vast amount of separation or potential energy there is in a pound of carbon. A pound of hydrogen in the ordinary gaseous state contains about four times this amount.

A pound of matter falling without obstruction from an infinite distance to the earth's surface would acquire a velocity of seven miles per second, and would strike with an energy of 10,600 foot-tons. But the molecular energy of a pound of hydrogen gas, which is liberated in combining with oxygen, is 23,600 foot-tons. In other words the chemical energy of hydrogen gas, if applied to its own mass to give it an upward velocity, is 2¼ times what would be necessary to project it to an infinite distance whence it could never return.

The energy of carbon is held back by a molecular obstruction that prevents it from undergoing a chemical change, or a fall of molecular potential, until sufficient external energy has been applied to overcome the obstruction. A mass of carbon may be allowed to stand in contact with atmospheric oxygen, or even pure oxygen, for ages, and not a single atom will oxidize, though the affinity of the carbon for the oxygen atom is enormous. After the separation of carbon from oxygen has once been effected, the carbon atoms unite with one another, and their mutual attraction, though small, constitutes an insuperable obstruction to the union with oxygen. This obstruction may be removed, however, by the application of a small amount of external energy in the form of heat, which breaks up the carbon and oxygen molecules and allows the atoms to exercise their affinities for each other. This is well illustrated in the kindling of a fire by applying a lighted match to a shaving.

In the transformation of molar potential energy into other forms there is no necessity for its primal degradation into heat; whereas, in the case of the molecular potential energy of all substances commonly called fuel, there is no known method of transformation except by a thermal or partially thermal process.

The first step in the process is to mix carbon with zinc oxide in a closed retort. Zinc oxide has a small amount of available molecular potential energy, but much less than metallic zinc. We apply to the retort, from an external source, sufficient heat to raise the temperature of the mass to about 1100° C. At this temperature the carbon is capable of taking oxygen from the zinc oxide and thereby undergoing partial combustion, a part of its energy being transferred directly to the zinc.

The following equation represents the change:

$$Zn\,O + C = Zn + CO.$$

The products of this reaction, Zn and CO, contain respectively 85,000 and 67,000 units of molecular energy, the original C containing 97,000. There must have been absorbed therefore from without, 55,000 units of heat. Of the 97,000 contained in the carbon, 30,000 have been transferred to the zinc, while 67,000 units remaining with the CO are not available for further reaction. We have therefore in the zinc 30,000 of the 97,000 units contained in the carbon, or about 31 per cent. as the possible maximum efficiency of the first step in the process. The next step consists in re-oxidizing the zinc in presence of an electrolyte with evolution of electrical energy in the galvanic cell.

Considering zinc merely as a transformer of energy, without any reference to cost of labor and materials, its efficiency in practice, at the very best, can scarcely exceed 2 per cent.

The amounts of coal required in practice for the reduction of one pound of zinc from the ore are given as follows:

	Pounds.
Roasting	.34
Reduction	1.25
Firing (external heat)	5.00
Total	6.69

This represents an expenditure of about 48,000 thermal units in effecting the reduction of one pound of zinc. The reduced zinc acquires only 1300 units, and if it were all available in a galvanic battery its efficiency as a transformer would be

$$\frac{1300}{48{,}000} = 2.6 \text{ per cent.}$$

But the reduction of zinc to the metallic state is not the only step in the process. The metal must be remelted, cast, rolled, amalgamated and properly connected in the cell. The mechanical preparation generally entails a loss of 5 per cent. In the final step the zinc is not all utilized. If the zinc be not well amalgamated, there is generally lost by local action from 50 to 90 per cent. It is safe to say that in actual practice of all kinds not less than 50 per cent. of the zinc of primary batteries finally deposits its expensive energy in an unavailable scrap heap. Assuming this figure to be roughly correct, we have the net efficiency of zinc as a transformer reduced to 1.3 per cent.

If zinc and atmospheric oxygen were the only substances required in oxidizing the zinc, the only limit to the maximum efficiency of this step in the process would be 100 per cent. But as a matter of fact we cannot oxidize even metallic zinc directly by atmospheric oxygen in such a way as to obtain electrical energy from it. It has a little more affinity for oxygen at low temperatures than carbon. Its energy may be transformed into electrical energy only by taking advantage of its affinity for other substances with which it forms "salts," instead of its affinity for oxygen. Such reactions take place in the cold readily and evolve greater energy than could be obtained by direct oxidation. Carbon, unfortunately, has no such affinities, and forms no such compounds as *salts*.

We have for heats of formation in solution:

	Units.
For zinc oxide, $Zn + O = ZnO$	83,000
" zinc sulphate, $Z + O + SO_3 = ZnSO_4$	108,000
" zinc chloride, $Zn + Cl_2 = ZnCl_2$	113,000

Unfortunately, the zinc salts formed as products of these reactions, $ZnSO_4$, $ZnCl_2$, etc., are not the original transforming substance, ZnO, and cannot be again reduced to metallic zinc without the expenditure of vastly greater amounts of energy than that required to reduce ZnO. So great is the energy required for the reaction of the sulphate, that, if we were actually to carry it out in practice, our efficiency of 1.3 per cent. would have to be again divided by a large number. Heretofore these products have always been thrown away in preference to reducing them.

Another serious loss in the zinc battery is that these by-products, which must be rejected, carry with them into the scrap heap, not atmospheric oxygen, but the (SO_4), Cl, or other expensive materials used in oxidizing the zinc.

The process, when operated with zinc as a transforming substance, is therefore not a complete or cyclic process, since the transforming substance never passes through the same condition twice. It is really more a process of transforming matter than one of transforming energy.

The objections to the behavior of zinc as a transforming substance teach us what is to be desired and what is to be avoided in seeking an ideal transforming substance. They indicate also that there is little hope for improvement in the method, so long as we employ zinc or any similar metal as a transformer.

I believe we may go even a step further and say that there can be no radical improvement in this method so long as the transforming substance constitutes at the same time one of the electrodes of the battery.

A galvanic battery, like any other apparatus, in order to be of great practical applicability, should be capable of maintaining its mechanical integrity. If we were to succeed even in substituting carbon for zinc in the galvanic battery of ordinary form, I believe it would result in no material saving; for carbon in a good mechanical form is as expensive as zinc in the same form. The most serious defect in the galvanic battery, as a mechanism for transforming energy, lies in the fact that it can operate only by destroying its own mechanical integrity to replace which is much more expensive than the mere materials of which it is built up.

What would be thought of the commercial utility of a steam engine that derived all its energy from the oxidation of its own piston rod; or of a steam boiler that could utilize no energy except what was derived from the oxidation of its tubes; or of a dynamo that could supply no electric current except what might be derived from the burning of its brushes or commutator?

Yet this is exactly the sort of mechanism we have in all galvanic batteries. The only energy that can possibly be evolved is that which comes from the mechanical destruction of the battery itself. This seems to me a much more serious difficulty than any difficulty arising from inefficiency in the actual transformation.

Nevertheless, the galvanic cell is the only known instrument by which chemical may be directly transformed into electrical energy, and there is no theoretical limitation to its possible efficiency.

The ideal cell should consist of two indestructible, or reasonably permanent, conducting solids, in contact with a liquid electrolyte. The electrolyte should consist of two solutions, separated by a porous partition, through which one of the solutions flows. Each of the two solutions should contain a chemical reagent capable of combining with the other, on contact of the solutions, in an exothermic reaction.

(To be continued.)

Effects of Hysteresis and Foucault Currents on Polar Diagrams.

BY FREDERICK BEDELL AND JAMES E. BOYD.

The treatment of problems involving simple harmonic currents and E. M. Fs. by means of vector diagrams is complete and rigorous. Simple harmonic currents and E. M. Fs., however, only exist in circuits without iron. In the presence of iron, the magnetization produced lags behind the current or magnetizing force which produces it, on account of hysteresis, and the coefficients of induction are not constant. Under such circumstances it may be proved*

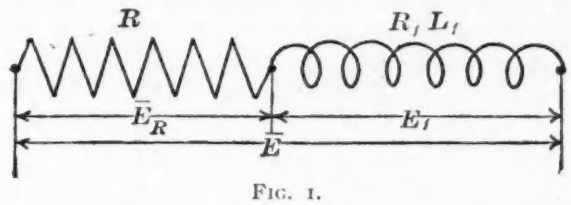


FIG. 1.

that the current and E. M. Fs. cannot both be harmonic.† If the impressed E. M. F. is a simple sine function, the current will be composed of sine terms‡ of 1, 3, 5, etc., times the fundamental frequency; or, conversely, if the current is a simple sine function, these odd harmonics will exist in the E. M. Fs. which causes it to flow.

It is true that non-harmonic currents and E. M. Fs. cannot be accurately replaced by equivalent sine functions in *all* their effects.§ The use of polar diagrams, therefore, based upon equivalent sine functions, is not entirely correct in general; it may be justified,

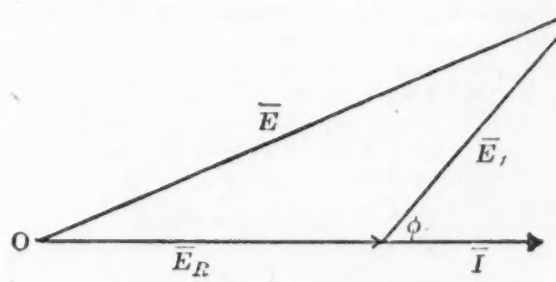


FIG. 2.

however, in many instances. We will note some of the effects produced by hysteresis and harmonics upon polar diagrams.

It may be shown that the phase position of odd harmonics do not influence the virtual or square root of the mean square value. Furthermore, the virtual values of periodic quantities that are not harmonic may be added and subtracted as vectors.

* See Rowland, *Philosophical Magazine*, Vol. XXXIV, p. 54; also THE ELECTRICAL WORLD, July 9, 1892.

† Harmonic is here used as meaning a simple sine function.

‡ Only odd harmonics can exist if each successive semi-period is a repetition of the preceding one

§ *E. g.*, capacity and self-induction cannot completely neutralize each other, unless the current is an exact sine function, as proved rigorously, *Transaction Amer. Inst. of Electrical Engineers*, p. 364, Vol. IX.

Influence of the Odd Harmonics Upon the Virtual Values.—Let $y = a \sin (x + a) + b \sin 3 (x + \beta) + \ldots h \sin p (x + \gamma) + k \sin q (x + \delta)$ represent the instantaneous values of current or E. M. F.

The mean square value of y is $\frac{1}{\pi}\int_0^{\pi} y^2\, dx$.

$$y^2 = a^2 \sin^2 (x + a) + b^2 \sin^2 3 (x + \beta) + \ldots + h^2 \sin^2 p (x + \gamma)$$

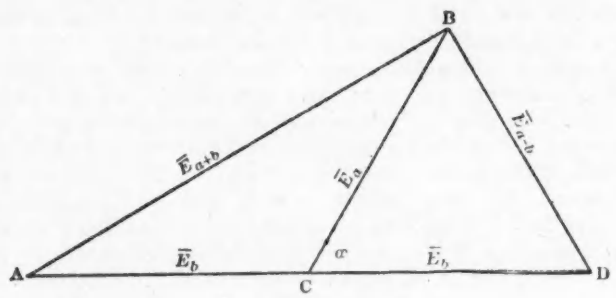


FIG. 3.

$$+ k^2 \sin^2 q (x + \delta) + 2 ab \sin (x + a) \sin 3 (x + \beta)$$
$$+ \ldots 2hk \sin p (x + \gamma) \sin q (x + \delta).$$

We may write the following integrals:

$$\int_0^{\pi} a^2 \sin^2 (x + a) = a^2 \left[\frac{x}{2} - \frac{\sin (x + a) \cos (x + a)}{2}\right]_0^{\pi} = \frac{a^2\pi}{2};$$

$$\int_0^{\pi} k^2 \sin^2 q (x + \delta) = k^2 \left[\frac{x}{2} - \frac{\sin q (x + \delta) \cos q (x + \delta)}{2q}\right]_0^{\pi} = \frac{k^2\pi}{2};$$

$$\int_0^{\pi} \sin p (x + \gamma) \sin q (x + \delta)$$

$$= \frac{1}{p^2 - q^2}\left[q \sin p (x + \gamma) \cos q (x + \delta) - (p \cos p (x + \gamma) \sin q (x + \delta)\right]_0^{\pi}.$$

When both p and q are odd, this last integral is zero.

Hence $$\frac{1}{\pi}\int_0^{\pi} y^2 dx = \frac{a^2 + b^2 + \ldots + h^2 + k^2}{2}.$$

The magnitude of the virtual value of a function made up of odd harmonics depends accordingly only upon the amplitude of these harmonics, and is independent of their phase positions.

Vector Representation of Non-Harmonic Functions.—The vector representation of non-harmonic currents or E. M. F. may be illustrated and justified in the following manner:

Figure 1 represents an inductive and a non-inductive circuit in series. Let $\bar{E}_1$ and $\bar{E}_r$ represent the virtual values of the E. M. F. at the terminals of the two portions of the circuit, and let $\bar{E}_{r+1}$ be the total E. M. F. Without any assumption as to the nature of these E. M. Fs. the power expended in the inductive portion of the circuit is in general in accordance with the principles of the three-voltmeter method,*

$$P_1 = \bar{E}_1 I \frac{\bar{E}^2 - \bar{E}_r^2 - \bar{E}_1^2}{2\bar{E}_r \bar{E}_1}.$$

If we represent the E. M. Fs., $\bar{E}$, $\bar{E}_r$, and $\bar{E}_1$ by vectors as in Fig. 2 and the current $\bar{I}$ as a vector in the direction of $\bar{E}_r$ it, follows from the geometry of the figure that

$$\frac{\bar{E}^2 - \bar{E}_r^2 - \bar{E}_1^2}{2\bar{E}_r \bar{E}_1} = \cos \phi.$$

Here ϕ is the angle between the vectors representing the current and E. M. F. $\bar{E}_1$ at the terminals of the inductive circuit. From the above equations it follows that

$$P_1 = E_1 I \cos \phi.$$

But this is the same expression for the power that would be obtained in case $\bar{E}_1$ and $\bar{I}$ were harmonic functions, and the angle ϕ was the true angle of lag between them. Accordingly Fig. 2 is correct for currents and E. M. Fs. that are not harmonic, and it has been seen that ϕ represents the equivalent angle of lag; that is the angle of lag of the equivalent harmonic current behind the equivalent harmonic E. M. F.

A similar vector diagram may be constructed for the currents in an inductive and non-inductive circuit in parallel, in accordance with the principles of the three-ammeter method.

Vector Addition of Non-Harmonic Currents and E. M. Fs.—A further justification of the use of vectors in representing functions that are not harmonic follows from the fact that such vectors are vectors representing true harmonic functions. Given two E. M. Fs. $\bar{E}_a$ and $\bar{E}_b$ of any form whatsoever: let their sum be $\bar{E}_{a+b}$ and their difference be $\bar{E}_{a-b}$. The vector addition is shown in the triangle ACB in Fig. 3; the subtraction is shown in the triangle BCD. If this vector addition and subtraction is correct, the angle between $\bar{E}_a$ and $\bar{E}_b$ in the two cases should be the same; that is, if the two triangles are placed together, as in the figure, with the side $\bar{E}_a$ of the one coinciding with the side $\bar{E}_a$ of the other, the side $\bar{E}_b$ of each should be in the same direction, and ACD should be a straight line. That this is so may be proved as follows:

If ACD is a straight line, we have the relations:

$$\bar{E}^2_{a-b} = \bar{E}^2_a + \bar{E}^2_b - 2\bar{E}_a \bar{E}_b \cos \alpha;$$
$$\bar{E}^2_{a+b} = \bar{E}^2_b + \bar{E}_b{}^2 + 2\bar{E}_a \bar{E}_b \cos \alpha.$$

By addition
$$\bar{E}^2{}_{a+b} + \bar{E}^2{}_{a-b} = 2\bar{E}_a{}^2 + 2\bar{E}_b{}^2.$$

$$\text{Now } \frac{1}{2\pi}\int_0^{2\pi} (e_a - e_b)^2 dt = \bar{E}^2{}_{a-b} = \frac{1}{2\pi}\int_0^{2\pi} (e_a{}^2 - 2e_a e_b + e_b{}^2)\, dt.$$

$$\text{and } \frac{1}{2\pi}\int_0^{2\pi} (e_a + e_b)^2 dt = \bar{E}^2{}_{a+b} = \frac{1}{2\pi}\int_0^{2\pi} (e_a{}^2 + 2e_a e_b + e_b{}^2) dt.$$

Hence by addition

$$\bar{E}_{a+b}{}^2 + \bar{E}_{a-b}{}^2 = \frac{1}{2\pi}\int_0^{2\pi} 2e_a{}^2 dt + \frac{1}{2\pi}\int_0^{2\pi} 2e_b{}^2 dt = 2\bar{E}_a{}^2 + 2\bar{E}_b{}^2$$

Hence ACD is a straight line, and the vector addition of periodic quantities which is not harmonic is proved to be correct.

The graphical test of this principle is shown in Figs. 3 and 4. In Fig. 4 e_a and e_b are two irregular E. M. Fs, represented by polar curves; their sum and difference are shown in curves e_{a+b} and e_{a-b}. The virtual values of these four curves, found by means of a planimeter, are plotted to scale in Fig. 3. The results are in accordance with the above proof, the line ACD proving to be practically a straight line, differing from one by an almost inappreciable amount, indicated by the dotted line. This discrepancy is within the error of the work.

(To be continued.)

Acetylene Motors.

Our French contemporary, *L'Industrie Electrique*, quotes a statement from an Italian journal to the effect that a Mr. Pedreti has constructed a motor operated by acetylene gas for running a bicycle; it can run 15 hours, weighs about 20 pounds, and can develop a useful power of 62 kilogram-metres per second, measured with a brake; the cost of the carbide consumed is not more than 1 cent per hour. Our French contemporary comments humorously on it and shows from the results that it would be more advantageous for electric central stations to manufacture the carbide for such motors, instead of using the current directly for motors; also that the carbide would then serve to produce economically the electric energy used for its own manufacture.

* If e represents an instantaneous value of E. M. F. (See Ayrton, *London Electrician*, Vol. 26, p. 735),

$$e = e_r + e_1; \text{ and}$$
$$e^2 = e_r{}^2 + e_1{}^2 + 2e_r e_1. \text{ Hence}$$
$$e_r e_1 = \frac{1}{2}\left(e^2 - e_r{}^2 - e_1{}^2\right); \text{ and}$$
$$\frac{e_r}{r} e_1 = e_1 i = \frac{1}{2r}\left(e^2 - e_r{}^2 - e_1{}^2\right).$$

The product, $e_1 i$, represents the power expended in the coil at any instant, and the mean value of this product is the mean power. Likewise the mean values of e^2 $e_r{}^2$ and $e_1{}^2$ are mean square potentials, which are read with a voltmeter. Hence we have

$$\text{Power} = \frac{1}{2r}\left(\bar{E}^2 - \bar{E}_r{}^2 - \bar{E}_1{}^2\right).$$

THE ELECTRIC RAILWAY

The General Electric Series-Parallel Controller for Four-Motor Equipments.

BY WILLIAM BAXTER, JR.

The controlling switches and other devices used by the General Electric Company for cars provided with four motors are the same as the type K2, used with two-motor equipments, but to adopt them to this purpose it is necessary to use an additional commutating switch. This switch is required, owing to the fact that the two-motor controller can only make two changes; that is, from two motors in series to two in parallel, whereas when four motors are used it is possible to make them combinations, namely, four motors in series, two series in parallel, with two motors in each series, and, finally, four motors in parallel. As the type K 2 controller can only make the first and second of these combinations, the commutating switch becomes necessary. By its use, when the handle is thrown to the slow-speed combination, the car can be run with the four motors in series, or on the second combination, which places the motors in two parallel circuits, with two motors in series in each circuit. If it is desired to use the third combination of four motors in parallel, so as to obtain the highest speed, the commutating switch is thrown over to the fast combination. Then the car will start with the motors in the second combination of two in series and two in parallel, and when the controlling switch handle is moved all the way around the four motors will be in parallel.

The commutating switch is placed where it can be reached easily by the motorman.

The number of rheostats, and with the four-motor equipments, is twice as great as with the ordinary K2 two motor cars. This, a little reflection will show, is necessary in order to keep the circuits of the several motors separate from each other.

The combinations made by the movement of the controller switch handle, from point to point, when the commutating switch is turned to the slow-speed combination, are as follows:

First: The full resistance of the two rheostats *KA* and *KB* in parallel with each other and in series with the four motors.

Second: One third the resistance of the two rheostats, in parallel with each other, and in series with the four motors.

Third: Same as second, but only one twelfth of rheostat resistance in circuit.

Fourth: The four motors in series with all the rheostat resistance cut out.

Fifth: Same as fourth.

Sixth: Same as second.

Six and one half: One third of rheostat resistance in circuit, rheostats in parallel, in series with the four motors, in series, motors Nos. 2 and 4 being short-circuited.

Seventh: Same as six and one half, except that motors 2 and 4 are open-circuited instead of short-circuited.

Eighth: Same as seventh.

Ninth: One third resistance of rheostats in parallel, in series with motor in two parallel groups, motors Nos. 1 and 3 being in series and in parallel with Nos. 2 and 4, the latter being also in series with each other.

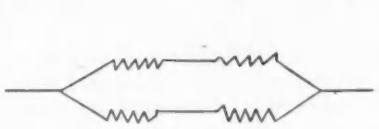


FIG. 2.

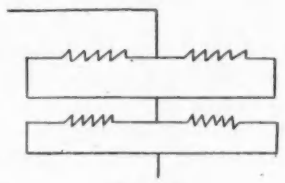


FIG. 3.

Tenth: Same as ninth, but only one twelfth of resistance in circuit.

Eleventh: Same as ninth and tenth, but no resistance in circuit.

Twelfth: Same as eleventh.

These combinations are effected when the contact fingers are in contact with the switch cylinders along the lines similarly marked in the development of the controllers.

Rheostats *K2A* shunt the fields of motors Nos. 3 and 4, and rheostats *K2B* the fields of motors Nos. 1 and 2.

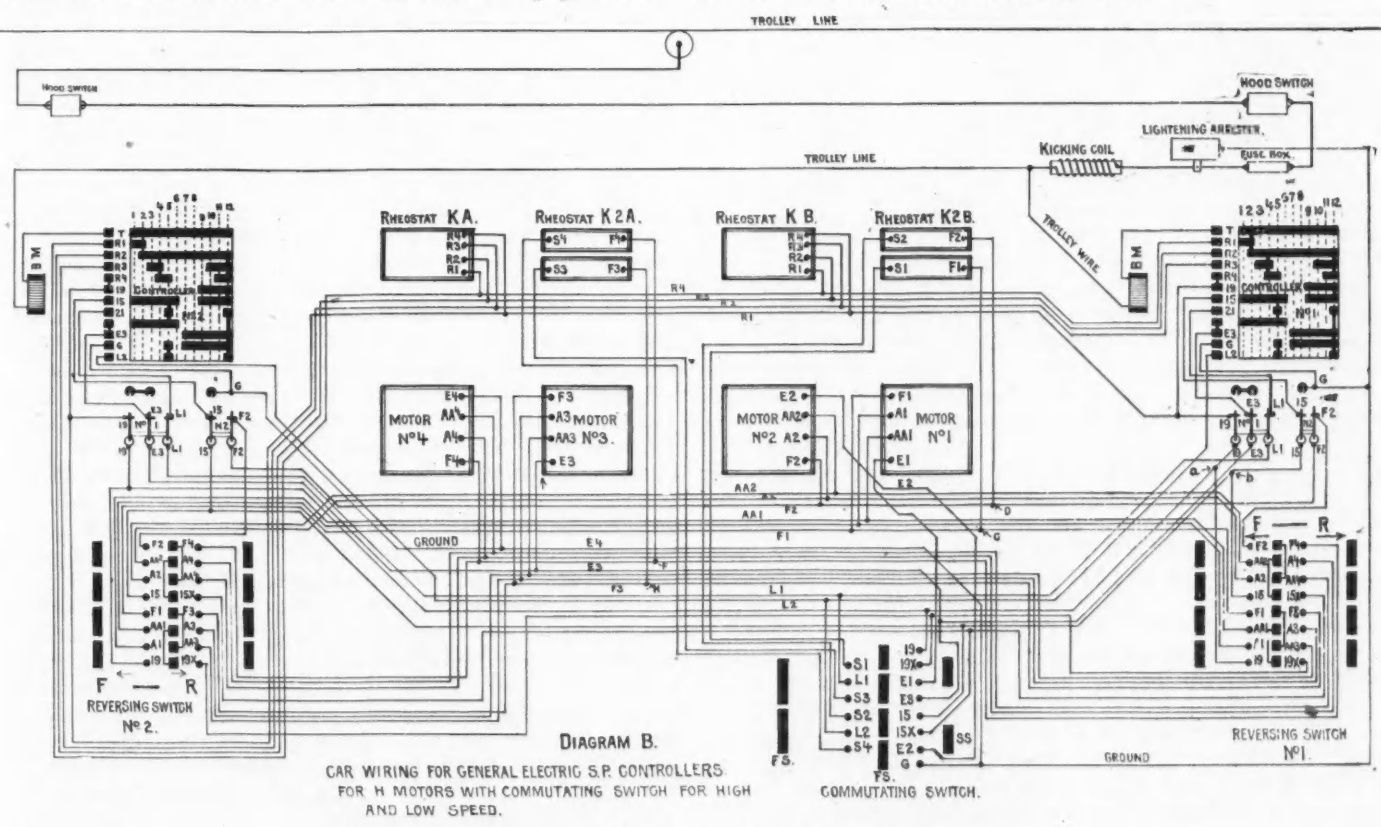


DIAGRAM B.

CAR WIRING FOR GENERAL ELECTRIC S.P. CONTROLLERS FOR H MOTORS WITH COMMUTATING SWITCH FOR HIGH AND LOW SPEED.

FIG. 1.—DIAGRAM OF CAR WIRING AND CONTROLLER CONNECTIONS.

Fig. 1 shows the arrangement of wiring for the four-motor equipments.

When it is desired to use the slow-speed combination, the commutating switch, shown at the bottom of the diagram, is turned so that the terminals of the several series may be connected with each other by the contacts marked *SS*. In this position the contacts will be connected as follows: 19*X* with *E*1, 15*X* with *E*2. In order that the diagram may be correctly understood, it may be well to state

that where the lines cross there is no connection unless a dot is shown.

With the commutating switch in this position, if it is desired to run the car forward under the influence of controller No. 1, the reversing switch of that controller, which is shown directly under it, is turned to the forward position marked *F*. Then the four long contacts to the left will connect *F*2 with *AA*2, *A*2 with 15, *F*1 with *AA*1 and *A*1 with 19. The eight short contacts in the centre will connect *F*4 with *AA*4, *A*4 with 15*X*, *F*3 with *AA*3 and *A*3 with 19*X*.

If, now, controller No. 1 is placed upon the first point the current in trolley series will pass from finger *T* to *R*1, thence to the two rheostats *KA* and *KB*, between which it will divide, the two being connected in parallel. From the rheostats it will return to upper contact 19 of No. 1 cut-out switch and through the switch to lower contact 19; thence to 19 of reversing switch. This contact being connected with *A*1 by the switch, the current will pass to the armature of No. 1 motor, and returning by *AA*1, will enter the field by *F*1, returning by *E*1, which goes to commutating switch and connects then with 19*X*, which is connected by wire with 19*X* of reversing switch. At the latter switch the current passes from 19*X* to *A*3, and thus to armature of No. 3 motor, returning by *AA*3 to the reversing switch, when it passes to *F*3 and back to the field of same motor, returning by 3 to lower *E*3 contact of No. *E*1 cut-out, thence to upper *E*3 and to *E*3 of controller.

As this finger is connected with the one above it the current enters a ring of the cylinder connected with the second one above it, and upon which 15 presses; therefore the current returns to upper 15 of No. 2 cut-out; thence to lower 15, and to 15 of reversing switch, where it connects with *A*2, and passes to the armature of No. 2 motor, returning to reversing switch by *AA*2, to enter the field of same motor by *F*2. Passing through this field it returns by *E*2 to the commutating switch, where it connects with 15*X* and passes to 15*X* of the reversing switch, which connects with *A*4, and thus sends the current to armature of motor No. 4. Returning by *AA*4 to the reversing switch the current passes to the field by *F*4, and from there by *E*4 to ground.

On the second, third and fourth points the course of the current is the same as on the first, with the exception that on the second step it passes from *T* to *R*2, thus short-circuiting a section of the rheostat resistances, and on the third point it passes direct to *R*3 and short-circuits two sections, while on the fourth point it passes to *R*4, and short-circuits the whole resistance of the rheostats.

On the fifth point the course of the current is the same as on the fourth.

The sixth step will be the same as the second.

Midway between the sixth and seventh points contacts 15, *E*3 and *G* are all connected together, as will be seen by the development of the controller cylinder, in which the ends of the rings thus marked are nearly in line. The effect of this is to short-circuit motors Nos. 2 and 4 through the connection between *E*3 and *G*, their circuits remaining closed on account of the connection with 15. As soon as the seventh point is reached this connection between 15 and *E*3 will be broken, and thus the cut-out motors, that is Nos. 2 and 4, will be open-circuited. The conditions will be the same at the eighth point. but at the ninth the connections made between 15 and 19 will connect Nos. 1 and 3 motors in series, and also Nos. 2 and 4, and the amount of rheostat resistance in the circuit will be the same as on the second point. The course of the current will then be as follows: 19 and 15 being connected with each other through the controller cylinder, there will be two paths for the current.

Following 19, first we will see that it will go to 19 of reversing switch. From here it will pass through the ammeter and field of No 1 motor, going to *E* 1 of commutating switch, when it will connect with 19 *X* and pass to 19 *X* of reversing switch, and thus through the ammeter and field of No. 3 motor, returning by *E*3. As *E*3 is grounded through the controller cylinder, this branch of the current will go no further. Taking up the current going through 15, we will find that it will pass to 15 of the reversing switch and from there through the ammeter and field of No. 2 motor, and pass to *E*2 of commutating switch, where it will connect with 15 *X*, and go to 15 *X* of reversing switch, and from here through the ammeter and field of No. 4 motor to ground by *E*4. On the ninth point, the motors, as shown above, are in two parallel circuits, Nos. 1 and 3 being in one circuit, and Nos 2 and 4 in the other. On this point the amount of rheostat resistance will be the same as on the third point.

The tenth point does not change the relation of the motors, but leaves them the same as on the ninth. The resistance is reduced, however, and is the same as on the fourth point.

The eleventh point cuts out all the resistance. The twelfth point does not make any change whatever.

From the foregoing it will be seen that when the connecting switch is set for the slow speed, the motor fields are not shunted; therefore there is no change in passing from the fourth to the fifth point, or from the eleventh to the twelfth.

If it is desired to run at a faster speed than this arrangement will give, it will be necessary to change the commutating switch to the fast combination and then the terminals will be connected by the contacts marked *FS*. The connections on the right will be: 19 with 19*X* — *E*1 with *E*3 — 15 with 15*X* — *E*2 with *G*. On the left the connections will be: *S*1 and *S*3 with *L*1 — *S*2 and *S*4 with *L*2. The course of the current on the first point with the commutation switch in this position will be as follows: From the trolley contact *T* it will pass through the rheostats in the same way as when the commutating switch was set for the slow combination.

Returning from the rheostats it will pass to wire 19, and at the junction a part will be diverted to the commutating switch, this being possible as now 19 and 19*X* are connected by this switch. The part of the current that continues on to 19, of the reversing switch, will pass through No. 1 motor and thence to *E*1 of commutating switch, where it will enter *E*3, and go to *E*3 of the controller, and thus to 15. The current deflected from 19 at *A* will pass to 19*X* of the reversing switch, through the connection made in the commutating switch. From 19 *X* of the reversing switch it will pass through No. 3 motor, returning by *E*3 and joining the current that passed through No. 1 motor, will go to the controller to contact 15. Following this wire the current will again be divided at *b*, a part going to 15 of reversing switch and thus through No. 2 motor to *E*2 of commutating switch, and to ground. The other part will go to 15 of commutating switch, being connected with 15 *X*, will enable the current to pass to 15 *X* of the reversing switch, and thence through No. 4 motor and the ground through *E*4.

From this explanation it will be seen that motors No. 1 and No. 3 are in parallel, and that the two branch currents after passing through them come together at 15 and again divide and pass through motors No. 2 and No. 4, which are also in parallel with each other.

The second, third and fourth points vary from the first only by cutting out sections of the resistance, all of which is cut out of the circuit on the fourth point.

The fifth point shunts all the fields in the following manner: The part of the current that passes through 19 of reversing switch after passing through the armature of No. 1 motor, proceeds to the field by *F* 1 and at the junction *C* a portion is shunted through lower rheostat *K*2*B* and passes to *S* 1 of commutating switch and from there by *L* 1 to *L* 1 of controller, thus connecting with *E* 3 and 15. The balance of the current passes through the field of No. 1 motor, and returning by *E*1 goes to the commutating switch, where it connects with *E*3 and passes to *E*3 and 15 of controller, thus joining the current that was shunted through the lower rheostat *K*2*B*.

The part of the current in 19 that passes at the junction *a*, to commutating switch and to 19 *X* of reversing switch, after passing through the armature of No. 3 motor, and on its way back to the field, by *F* 3, is shunted at the junction *H*. The part that continues through the field returns by *E*3, to the controller. The shunted part passes through lower rheostat *K*2*A* and to *S*3, of commutating switch, when it connects with *L*1, and goes to *L*1 of controller and thus joins the current that passed through field of No. 3 motor.

It will be remembered that motors Nos. 1 and 3 are in parallel, and that the terminals of their fields, that is *E*1 and *E*3, are connected together and join 15, therefore the wire *L*1 serves as a path from the commutating switch to the controller for the two currents shunted around the fields of these motors, and these currents are independent because they only have one common terminal, the others being independent, one starting from *C*, and the other from *H*.

The fields of motors Nos. 2 and 4, are shunted in the same way. The current from No. 2, being diverted at *D*, through upper rheostat *K*2*B* to *S*2, of commutating switch and to *L*2, of controller, where it grounds, the current of No. 4 being deviated at *F*, and after passing through upper rheostat *K*2*A*, goes to *S*4 of the commutating switch, which is also connected with *L*2, through which the current passes to *L*2 of controller and ground.

The sixth point gives the same connections as the second.

Midway between the sixth and seventh point, 15 *E*3 and *G* are all connected, therefore the current passes directly from *E*3 to ground, and thus constant motors No. 2 and 4, but as 15 is also connected these motors remain short-circuited, although constant. At the seventh point the connection between 15 and *E*3 is broken, but

that between $E3$ and G remains, therefore these motors will now be open-circuited as well as cut-out.

On the ninth point 15 and 19 are connected, and this connection places all the motors in parallel, for, as will be seen, the current passing through 19 will be divided at *a*, and pass through motors Nos. 1 and 3 in parallel, and the current through 15 will be divided at *b*, and pass through motors No. 2 and 4 in parallel. The two currents through 15 and 19 being themselves in parallel, it follows that all the motors will be in parallel.

The tenth and eleventh points cut out the resistance, the motors being in parallel, with full fields and no resistance in the circuit on the eleventh point.

The twelfth point shunts all the fields. The connections made to accomplish this are the same as on the fifth point. To see this clearly it must be remembered that one end of each shunting resistance is permanently connected with one terminal of the field it is used to shunt. These connections are shown at the points C, D, F, H, on the wires $F1$, $F2$, $F3$, $F4$, respectively. The other terminals of these rheostats are connected in pairs with $L1$ and $L2$ through the commutator switch lower $K2$ A and $K2$ B with $L1$, and upper $K2$ A and $K2$ B with $L2$. On the twelfth point $L1$ and $L2$ are connected with $E3$ and G, and thus the circuit through the shunting rheostats is closed.

The cut-out switches cut out the motors in pairs. This may seem strange at first, as there would appear to be no reason for cutting out a motor unless it is disabled; but as they are connected so as to work in pairs, this is necessary. If only one motor were cut out we would then have in the first connection with commutating switch set for fast speed, one motor in series with two others which would be in parallel, and thus this one machine would take as much current as the other two.

On the second combination, with commutating switch set for slow speed, there would be one motor in parallel with a series of two motors, therefore one motor would have to balance the whole E. M. F. of the circuit, while the other two would only balance one half each.

The connection in the two cases would be as in the following design.

The operation of the cut-out switches is as follows: If No. 1 is raised, 19 and $E3$ will be connected, as shown by the contact directly above them. Then no current will be able to pass to 19 and $19X$ of reversing switch, and as a result, motors Nos. 1 and 3 will be open-circuited. If No. 2 cut-out is raised, 15 will be grounded by the upper contact. The current will then pass through 19 and $19X$ to and through motors Nos. 1 and 3; but after coming together at 15 will pass to ground, and motors Nos. 2 and 4 will be open-circuited.

Although the second combination, when the commutating switch is set for slow speed, is the same so far as the relation of the motors is concerned as the first combination with this switch set for fast speed, the wire connections are different. In the first case the motors are connected in two parallel series, there being two motors in series in each circuit. This is shown clearly in Fig. 2.

It will be noticed that in this case motors Nos. 1 and 3 are in series in one circuit, and Nos. 2 and 4 are in series in the other circuit.

In the second case, which is the first combination of the fast speed position of the commutating switch, the connections are shown in Fig. 3.

It will be noticed that in this arrangement, motors Nos. 1 and 3 are on a parallel, and those two parallel groups are in series with each other.

The difference between the connections in the fast and slow speed positions of the commutating switch is due to the fact that, in the slow speed the car starts with a series of four motors, and to change to the parallel connection this is divided into two series of two motors each. The two series being placed in parallel, but in the fast speed combination, the car starts with two parallel groups in series and the groups are placed in parallel with each other when the parallel connection is reached.

Death of George Law.

Mr. George Law, president of the Eighth and Ninth Avenue Railway Companies, and one of the best known men in New York City, died at his home on Fifth Avenue on July 8 of spinal meningitis. He was taken ill early in June last, and although he was recovering from the original ailment, spinal meningitis ensued, with fatal results. Mr. Law was born in New York City on Nov. 17, 1843.

The Ithaca Street Railway.

ITHACA is a city which is full of natural problems to the street railway man. There are gorges to bridge, enormously steep gradients to mount, and other difficulties on the road. There is an abundance of available water power for operating the station, but the station must, of necessity, be situated in an extremely difficult position to deliver to it the necessary supplies, and also the coal to be used in the reserve equipment in case the water power fails. It is altogether an ideal situation for the engineer who delights in difficult problems, and for this reason a description of the electric railway system employed there is of more than ordinary interest.

This road, which is about a ten-car road, is operated by water power, the water having a head of 94 feet. The power-house, situated in what is called Fall Creek gorge, some 200 feet below the level of Cornell University, although on a horizontal distance it is scarcely more than 150 feet away from the nearest University building. An idea of its location can be obtained from the illustration, Fig. 2. The top of the gorge can be seen, and also the small foot bridge crossing the stream supplying the power to the station. This stream is not over 100 feet wide at its widest point, but its enormous velocity gives it great power. At the left hand corner of the power-station, as seen in the illustration, there is a waterfall about 80 feet high. Another fall about 400 yards upstream is 30 feet in height and at this place the water is dammed and directed into the flume by which it is

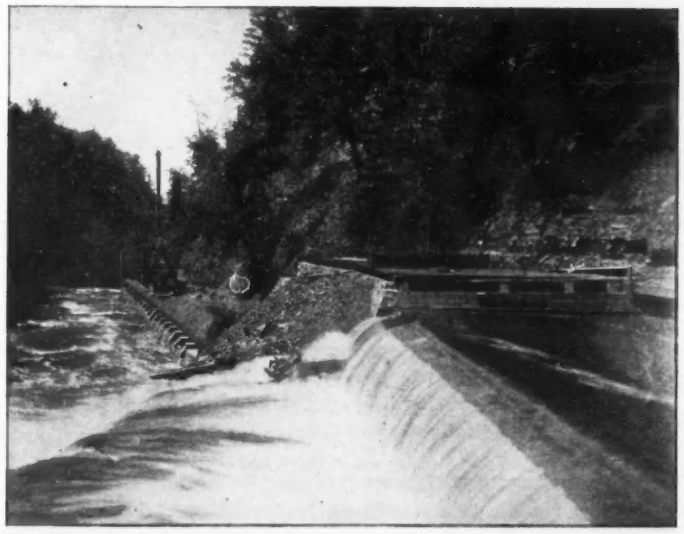


FIG. 1.—FLUME.

carried down to the power-house. Fig. 1 also gives an idea of the construction of the flume, and the stack in the distance locates the power-house. The water passes down this flume and at the level of the base of the lower falls it divides into two flumes and supplies two turbines of 400 horse-power each, which were built by the American Water Wheel Company. These turbines are controlled and governed by a Replogle water-wheel governor of the relay type. This machine is a recent product of the Replogle Company, and its wonderful accuracy in governing makes it worthy of a somewhat detailed description. The principle of the governor is shown in Fig. 3. A wheel is belted to the shaft and drives a crank-plate, which reciprocates a pair of pawls over a toothed wheel. One of these pawls is adapted to drive the toothed wheel in one direction and the other to reverse that motion. These pawls are thrown in and out of action by magnets as shown in Fig. 3. A small centrifugal governor is driven by a narrow belt, and its collar operates a little lever which by a multiplied motion switches the electric current from one to the other of these magnets, as the case may require. The duty on the governor is therefore very light

and it is free to change its position with the changes of speed. The pawls, of course, respond promptly to the dictates of the little moving contact controlled by the governor collar. The wheel thus driven by the pawls turns a shaft, on one end of which is carried a pinion which engages a rack. This rack does not operate the gate to the water-wheel, as is commonly the case, but instead, raises and lowers

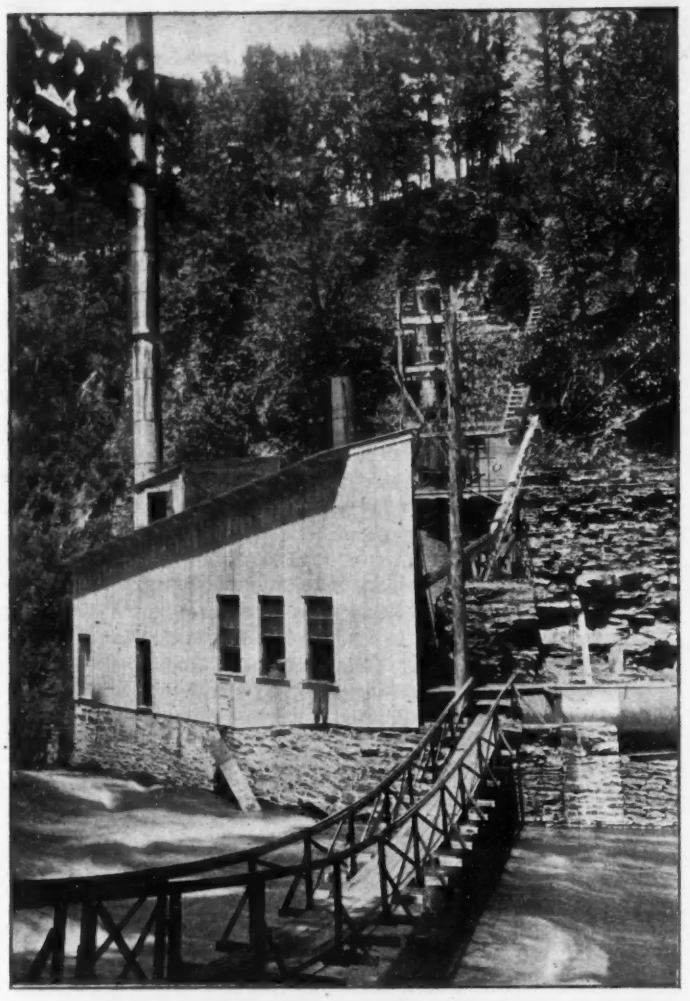


Fig. 2.—Power House, Ithaca Street Railway.

a sleeve which surrounds the discharge-pipe. A certain distance below the discharge-pipe a sheet-metal cone is placed, and this sleeve controls the discharge area, by lowering down onto the sheet-metal cone as shown. The tail-water is thus backed up to the turbines when the load falls off, and the discharge is made free when the load becomes heavy. By this means the head on the turbines is practically a constant quantity, and there is no ramming in the flume. The flume is further protected from the influence of sudden motions of water contained in it by means of two air-chambers, one on each branch leading to the turbines. These air chambers are provided with gauges, so that the amount of air they contain can at any time be readily ascertained. The turbines are direct-connected, each to a rope pulley, which, by means of 19 ropes, drives a jack-shaft 70 feet above. An idea of the rope transmission can be obtained from Fig. 4.

The jack-shaft extends the whole length of the station, is 5 inches in diameter, and runs at 350 revolutions per minute. A view of it is shown in Fig. 7. The rope transmission can be seen at the further end, while belts to the railway and lighting generators pass from the shaft to machines in the rear of the illustration. The shaft is well supplied with friction clutches, which enable it to be cut up into sections, so that either wheel may drive any machine and the equipment may be generally flexible.

The available water-power varies from a very large amount in the flood season down to 300 horse-power in the dry season. At times of flooding the water has been so high that it has run several feet in depth above the bridge shown in Fig. 2. The jack-shaft drives two multipolar generators of 100 kilowatts each. One of them is of the Thomson-Houston make and the other is of a similar type, but was made by the combined Edison and Thomson-Houston concerns after their consolidation. Both machines operate in multiple from 550 to 600 volts, thus being 20 per cent. over-compounded. They deliver their current to a slate switchboard of the ordinary type. All the wiring is on the rear of the board. The equalizer machines are connected together by equalizers, which are operated by the middle blades of three-pole switches. The ammeters are of the Thomson-Houston pattern, as are also the rheostats and circuit-breakers. Observing the ammeters for a few moments, it will be seen that the load of the railway equipment is a very variable quantity. The circuit-breakers are said to have 200 amperes each, and within the short space of five minutes the writer noted the load changed from zero to full load. Fig. 5 illustrates the dynamo room.

Should the water power become deficient a steam plant is provided which belts onto a pulley, which can be clutched onto the jack-shaft when necessary. Steam is generated in a Root water-tube boiler rated at 200 horse-power, and also in a 200-hp upright Manning boiler, both of which are bricked in in the ordinary manner.

At first considerable trouble with scale was experienced, but by the judicious use of kerosene oil and frequent blowing off it is prevented from adhering rigidly to the plates, and has since caused very little trouble.

A grade of buckwheat coal is used, which is delivered in a square chute from the top of the gorge. In Fig. 2 the coal chute may be seen entering the station. The steam is delivered to a tandem compound-condensing McEwen engine. The cylinders are 14 and 28 inches and the stroke is 20 inches. In Fig. 3 it will be seen that the high-pressure cylinder exhausts directly into the lower pressure without the interposition of a receiver. The engine is belted backward onto the jack shaft.

Perhaps the most interesting part of all is the road and the rolling stock. The highest grade is 11.6 per cent. and the cars average upon it 88 to 90 amperes each, running at the rate of six miles an hour. Each car weighs about 9¼ tons. The motors are fused with 100

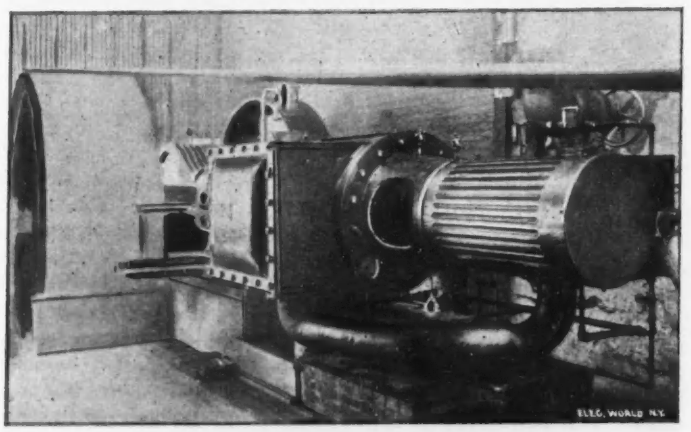


Fig. 3.—Tandem-Compound Condensing Engine.

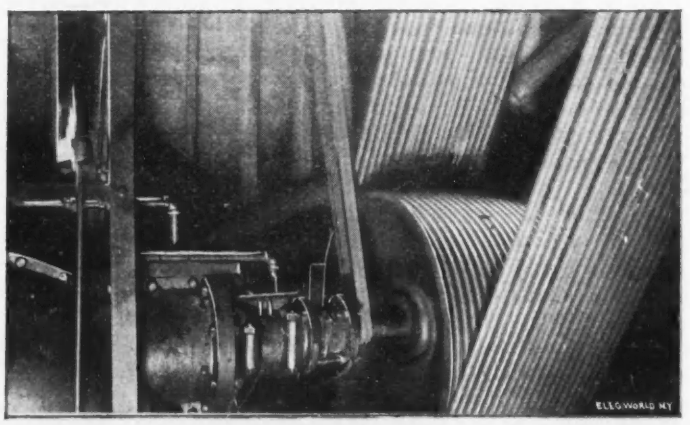


Fig. 4.—Rope Transmission.

ampere fuses and the brake rigging is only the ordinary equipment provided for the Bemis and Peckham trucks with which the cars are equipped. Wooden poles carrying No. 0 trolley wire support the overhead construction.

The motors are G. E.-800 and W. P.-50, and appear to take the grades without the least lifficulty. As far as economy is concerned,

the G. E.-800 is the superior motor, but the W. P.-50 is said to do beautiful work in mounting grades, and is a thoroughly reliable machine. On one of the grades there is an extremely sharp curve of not more than 25 feet radius, and this curve is dodged in a very ingenious manner. The road is single-tracked, with turn-outs, and the curve is utilized as a turn-out. A car coming up the hill continues on past the curve which forms one leg of a Y and passes further up the hill to the other leg of the Y. In this position it waits for the down-coming car, which passes around the sharp curve on the down

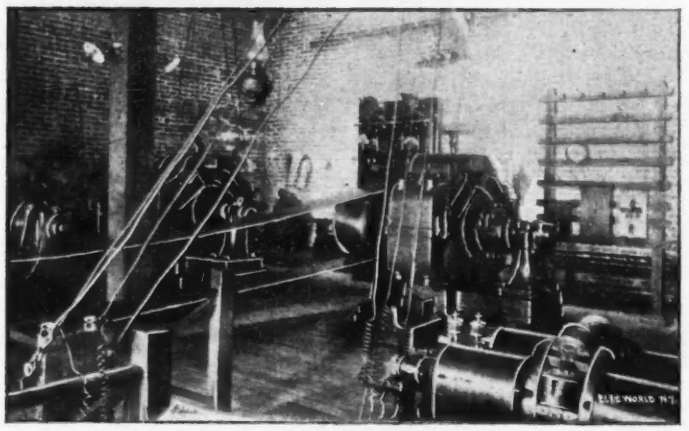


FIG. 5.—DYNAMO ROOM.

grade. The waiting car now starts down the grade on the second leg of the Y and obtains a good impetus before it is again obliged to mount upward on the path at right angles to its original course.

In the centre of the town, where the streets are paved, special blocks have been laid, and the road construction looks fully as neat and substantial as with the girder rail. It goes far toward convincing the street railway engineer that the T-rail is superior to the girder by having the metal it contains where it can be of the most service. The argument that the street cannot be properly paved is no longer valid. Further than that, it is impossible for a team to obstruct the track by getting the wheels on the flange, as is the case with almost every girder rail in existence. The wheels of vehicles are less wrenched in crossing over or turning out of tracks, and in many other ways the T-rail system has scored a marked success in Ithaca. The rails were rolled by the Lackawanna Iron & Steel Company, and run 60 and 45 pounds to the yard. They are bonded with No. 60 Chicago bond, and also with the Ohio Brass Company's bond. No trouble has been experienced due to electrolysis. The cars are fed with three lines of feeders, each of which is equivalent to No. 000 wire.

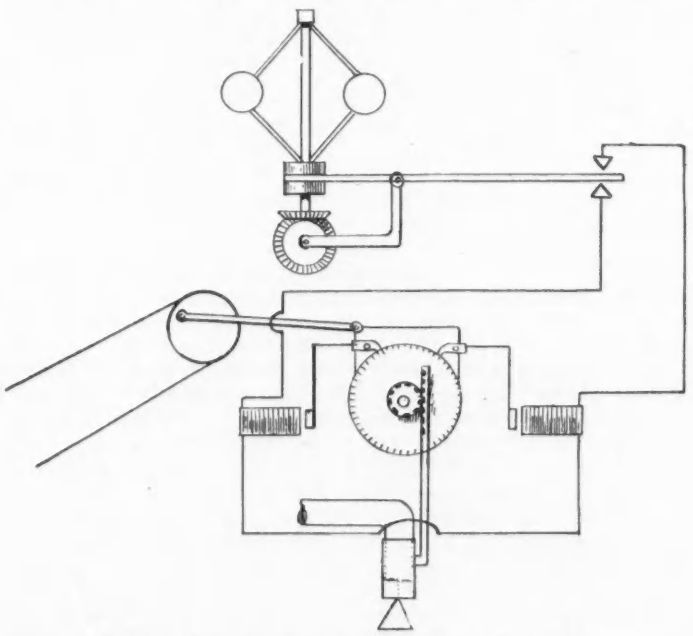


FIG. 6.—DIAGRAM OF RELAY WHEEL GOVERNOR.

Gilbert cars from Troy, Brill cars and Jackson & Sharp cars are used. They are 24 in number; 14 are open and 10 are closed. The company also has a baggage and freight car, One of the open cars is exceptionally long, having 15 benches.

There are two car barns having a capacity of 35 cars, one of which is used for storage and one for cars in active service.

The road is a notable instance of how promoters have taken ordinary standard apparatus and adapted it to combat with problems that would have been in other places the source of an enormous amount of engineering discussion, legal delay and general obstructive tactics to its development. In New York a 11.6 per cent. grade

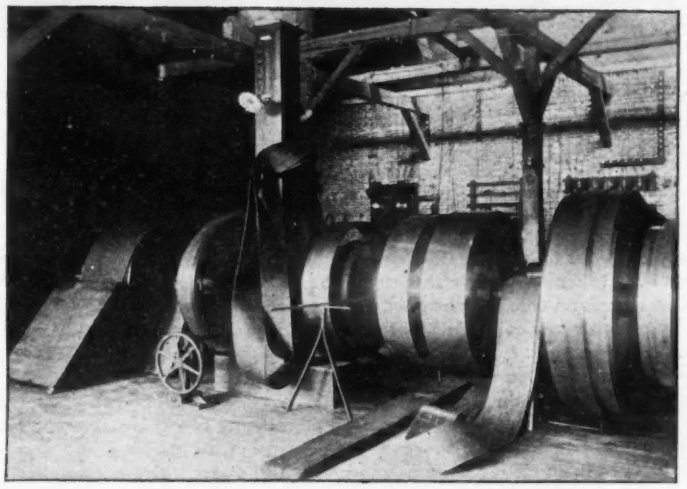


FIG. 7.—JACK SHAFT.

was looked upon as an insurmountable difficulty by the Rapid Transit Commissioners, Bridge Trustees and smaller bodies of authority, but in Ithaca such problems as this are of frequent occurrence and are taken as a matter of course, and but very little preparation has been made to allow for them as conditions out of the ordinary.

The Ithaca road is a triumph for the electric system of traction, and effectively demonstrates that under such severe conditions it is not inferior to the cable system in any respect, and is superior to it in many important qualities.

Decision Regarding the Overcrowding of Trolley Cars.

The State Railroad Commission, which has been investigating the cause of the accident on the Nassau Electric Railway in Brooklyn on June 7 last, has made public its decision regarding the same.

The decision says that while the immediate cause of the accident was the trolley wheel leaving the wire, the Board is of the opinion that the primary cause was the overcrowded condition of the car. The evidence does not substantiate the claim of the officers of the railway company that the fault lay with the motorman in not first applying the hand brake, instead of trying to stop the car by using the motors. On the contrary, the Board says all the evidence shows that the motorman did apply the hand brake as soon as the trolley wheel jumped the wire.

The Board recommends that on all lines of electric or cable railways in this State passengers should be absolutely prohibited from riding on the running boards or side steps of open cars, and that cars be not allowed to proceed so long as persons are standing upon either of these steps and refuse to get off the car or stand.

The decision further states:

"All cars operated on a grade of 5 per cent. or more should be equipped with an auxiliary brake, or with some appliance which may be used by the conductor or motorman in stopping the car. A simple device used by the Albany Railway Company on the State Street hill in the City of Albany, where the grade is even greater than on Thirty-ninth Street, Brooklyn, is a so-called dog attached to a chain running up through the rear platform of the car, by which it is held up when not in use. This is always dropped by the conductor before ascending the hill, and materially aids in holding the car when a stop is made. The Board recommends that this or some similar device be placed on all electric cars in the State used upon streets where the grade is more than 5 per cent., and also calls the attention of street railway managers to the new auxiliary brake on the new cars of the Third Avenue cable line in New York City.

"The Board further recommends that when ascending grades of 5 per cent. or more conductors be directed to remain on the rear platform, prepared to protect the trolley pole or assist in applying the brakes in case of emergency and that the brakes and trolley pole apparatus on all electric cars be carefully examined after each round trip."

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating-Current Motor. DAVIES system. Lond. *Elec. Rev.*, June 26.—An illustrated description of this motor, similar to the one abstracted in the *Digest* last week.

The Lond. *Elec.*, June 26, contains a short communication from Prof. S. P. Thompson headed "The Worship of the Power Factor" in which he refers to the comments made by that journal on the low power factor of the Davies motor (see *Digest*, last week); he thinks that an exaggerated view has been taken of the power factor; when a motor as small as 0.75 horse-power gives an efficiency as good as 90 per cent., he would not care if the power factor was even still smaller than it is; for larger motors it would naturally be higher; in transformers a high power factor is of importance to the company but not to the consumer and then only when it runs many hours a day on no load; motors are run only when wanted, and then at a normal or fair load; if then by sacrificing the unimportant detail of an ideal power factor one can gain the practical result of an exceptionally high efficiency with a good starting effort, why object to the power factor? This is followed by a communication from the writer of the article, in which he answers this by giving a table of a test of a 0.5 hp motor of this type; an efficiency of 81.4 per cent. was obtained in this case with a load factor of 70.04 per cent.; if this is possible with such a small output, surely better results are possible with a 0.75-hp motor. This is followed by a communication from Davies giving briefly the results of another experiment.

24,000-Volt Alternator. Elek. Zeit., June 25.—At the recent annual meeting of the German Electrical Society, von Dobrowolsky exhibited an alternator made by the General Electric Company, of Berlin, which generates three-phase currents at 24,000 volts; no further information is given.

Alternators with Stationary Armatures and Fields. L'Ind. Elec., June 25.—A well illustrated description of a new type of machine made by the Oerlikon Company in Switzerland.

Self-Induction in the Armatures of Alternators. BENISCHKE. *Elek. Zeit.*, June 18.—A reply to the recent criticism of Breslauer.

Transformers and Induction Motors. SCHULZ. *Elek. Anz.*, June 11.—Some simple formulas for the practical calculation of such apparatus.

Tests of Large Three-Phase Transformers. KORDA. *Elek. Zeit.*, June 25.—An illustrated description of a large 160-kw transformer for three-phase currents made by a French company, and the results of some tests of the same. The three cores are all in one plane, and are connected by common yoke pieces; the tests showed that on open circuit the losses on the middle core were different from those on the outside ones; when loaded, however, this difference disappears entirely; the efficiency was found to be 97 per cent.; it has a heat radiating surface of 17 sq cm per watt lost.

Single-Phase Alternate-Current Transformers in Practice. BERRY. Lond. *Elec. Rev.*, June 19 and 26; a reprint of a paper read before the student members of the Institution.—It is somewhat elementary in character and appears to contain nothing new or of special importance.

A Study of a Three-phase Motor. VAN LAW and SIMPSON. *Sibley Jour.*, June; reprinted in *Elec. Eng.*, July 8.—A description of a test made at Sibley College with a small three-hp, three-phase motor, by a method applicable to machines of any size. A direct current generator with connections for three-phase currents was tried without success; fair results were however obtained with another of the Gramme type, but ordinary excitation failed entirely until another direct current generator was placed in series with the direct current brushes; only two transformers were at hand, of which the two primaries were connected in series, as also the two secondaries; one brush of the dynamo was connected to the junction, and the other two to the free ends, a method which worked with entire success, except that there was some difficulty at first owing to the poor regulation with induction loads; two wattmeters were used, the sum of whose readings gave the total power; an efficiency curve showing remarkably good results is given; also torque curves for different starting resistances in the armature circuit.

Commutator Resistance. EDSALL and RORTY. *Elec. Eng.*, July 8.—A reprint of an article abstracted in the *Digest*, July 11.

LIGHTS AND LIGHTING.

Electric Light on the Suez Canal. Elek. Zeit., June 18.—Of the 3434 vessels which passed through the canal in 1895, 3266 or 95.1 per cent. used the electric light in order to be able to continue the trip through the canal during the night.

Street Lighting with Arc Lamps. BLONDEL. *Elek. Anz.*—A German translation of the series of articles abstracted some months ago in the *Digest* is being published in this journal in the June numbers; most of the illustrations seem to be included.

Electric Light in Mining Operations. BAXTER. *Eng. & Min. Jour.*, July 4.—He advocates a system of arc lights located in sheltered positions, with reflectors projecting their light upon the headings.

POWER AND HEAT.

Electric Plows. Lond. *Elec.*, June 26; a few figures obtained by a German company.—The power required was 11 kilowatts when ploughing a width of 24 inches and at a depth of 14 inches at the rate of 88 yards per minute; the area ploughed in a 10-hour day at this rate would be 7.5 acres. "The apparatus is so arranged that parallel to the motor car there runs at the other side of the field a car carrying the other end of the wire rope. The plow is hauled along this rope to and fro and both cars are slowly moved on. The greatest difficulty seems to lie in the fixing and moving of the pulley car."

Comparison Between Electric Motors and Small Gas Engines. SOUBEYRAN. *L'Eclairage Elec.*, June 6.—He shows from measurements in which (presumably) the current was taken from a central station, that electric motors of small power are comparable with gas engines in cost, but if the advantages are considered and at the price of gas and electricity in Paris, the advantages are in favor of electric motors up to about four horse-power.

Transmission Plant in Spain. Lond. *Elec. Rev.*, June 26.—An illustrated description of a water-power plant supplying light and power to two towns in the province of Valencia; there are two sets of direct-coupled alternators of 150 horse-power; transmission is at 6500 volts and the distance is about 18 miles.

Electrical Heating of Wool Presses. MUELLER. *Elek. Anz.*, June 14; a brief, illustrated description of the SARFERT system.—In pressing woolen fabrics in order to give them a smooth, fine appearance, both a uniform pressure and a uniform heat are required; in the present system the heating is done electrically, the fabric being placed between the metallic plates through which sufficient current is passed while under hydraulic pressure to heat them to slightly more than the temperature of boiling water; one dynamo of 50 volts and 700 amperes will suffice for five presses having 120 plates to be heated; the cost of heating for one press for a period of half an hour and for 70 plates, is about 12 cents; that the system is a success is said to be shown by the fact that a company which has tried it has just ordered 12 more presses.

Transmission of Power. Eng. News, July 9.—A note stating that electric power made it possible to operate profitably the Virginius mines in Colorado, which are situated in a region of perpetual snow 12,700 feet above the sea; access was difficult in Summer and impossible in Winter; fuel cost $18 a ton; electric power is now derived from a water-fall four miles distant; the voltage is 800 and the current is direct; the amount of power now is double that formerly used, and the saving is said to pay each year the entire cost of the plant.

Power Transmission. SCOTT system. *Elec. Eng.*, July 8.—A brief, illustrated description, taken apparently from the patent specification, of a system in which a single phase current is split up so as to produce a rotary field in a motor. The system was illustrated in THE ELECTRICAL WORLD, July 11, page 63.

TRACTION.

Three-Phase Traction System at Lugano. ROUTIN. *L'Eclairage Elec.*, June 13; another illustrated description of this line.—At the conclusion he states that if cars are to be run at greater speeds in the suburbs, the motors can be so wound that the number of poles can be varied; or the suburban line might be provided with current at a different frequency; for short steep grades, the power of the motor might be increased by increasing the field density, or by increasing the voltage by means of a transformer carried on the car; although the earth return is used there is no fear of electrolytic action on water and gas pipes, and the effect on telephone lines can be neutralized entirely by using a metallic circuit for these lines. The tests began December last and the results are said to show that the problem of electric traction by three-phase currents may be considered solved in practice.

Electric Line up the Gornergrat at Zermatt. Elek. Anz., May 31.—Some additional information regarding this three-phase mountain line, including an estimate of its cost and the income.

Electricity on Steam Railroads. Elek. Anz., June 18.—A brief description of the road from Meckenbeuren to Tettnang, which is said to be the first regularly running electric railway in Europe to take the place of a regular steam line carrying both freight and passengers ; the trolley system is used ; the power station also supplies light and power to the two villages ; the source of power is obtained from a 120-hp water fall ; the length of the line is a little less than three miles ; there are two motor cars which are also used as freight and passenger cars, each having two motors of 24 horse-power each, the total weight being 13,800 kg; the draw bar pull is 350 kg at a speed of 30 km per hour; a battery of accumulators is to be added to the station whereby its capacity will be doubled.

Sectional Contact Rail System. Lond. *Eng'ing*, June 19.—A brief description, without illustrations, of the PRINGLE and KENT system; there is a central sectional surface rail, only that length which is under the car being for that moment alive; there is a distribution box for every 24 contact pieces containing the necessary switches for making the respective sections alive; when the car makes contact with the dead section in front of it, it couples together to adjacent sections, which in turn shunts a magnet in the distribution box, thereby allowing a spring to move a switch-arm, making that new section alive and cutting out the old; the magnet is again energized when the car is only over one section; the distributor is filled entirely with heavy oil; with a slight modification it may be adapted to a single track with traffic in both directions; the cost is given as about $12,500 per mile, including only the electrical road equipment, and not the rails or the power-house.

Surface-Contact System in Paris. JACQUIN. *L'Eclairage Elec.*, June 6, 20 and 27.—Beginning of a long, illustrated description of the Claret-Vuilleumier system, which has been referred to a number of times in these columns.

Conduit System. Elek. Anz., June 14 and 18.—An illustrated description of the LACHMANN system, brief descriptions of which have already been published in these columns.

Electric Traction in the Paris Sewers. L'Ind. Elec., June 25; a short, descriptive note.—For some time past accumulator locomotives have been used; more recently an electromagnetic towing system known as the de Bovet system has been installed, the result of which was a great reduction in the number of attendants; the number of men required in these sewers has thereby been reduced by 57; prior to the introduction of the electric system the cars were drawn by men.

Electric Road Carriage. Lond. *Eng'ing*, June 12.—A brief, illustrated description of a carriage built for the Queen of Spain. It is said to be operated by a primary dry battery which weighs only 2 cwt., and will generate sufficient energy to run at a speed of 10 miles an hour and at full or half speed for 60 hours without attention; it can be re-charged easily and cheaply by the driver himself without the aid of a charging station. (The statements do not seem to be made authoritatively.)

Austrian Electric Railway Statistics. Elek. Zeit., June 15.—A full page table giving some operating statistics for the first quarter of the present year for each of eight different roads.

Electric Traction. BAKER. Lond. *Elec. Eng.*, June 26.—A reprint of a memorandum committed to the Highways Committee of the London County Council detailing the growth, cost and necessity for electric traction on railways; it includes a table of some interest, giving the total mileage of electric and other mechanical traction in Europe, running and under construction at the beginning of this year; the total is 866 miles, of which slightly over half is in Germany, after which comes France with about one eighth.

Rheostat and Series-Parallel Controllers. DECKER. *Rose Technic*, June.—A brief extract of a thesis describing tests made on the Louisville line with the aid of a Thompson integrating wattmeter, a recording wattmeter and a volt and ammeter; there were 40 stops during each trip; the result showed a saving of 14 per cent. for an unloaded car and 12 per cent. for a loaded car, in favor of the series-parallel controller; the number of stops, the load and the track were the same for each controller, the saving being therefore entirely in the starting, as the watts used were the same while running; it shows that in a city where the stops are very frequent the series-parallel controller is the more economical.

Compressed Air for Street Car Motors. HAUPT. *Elec. Eng.*, July 8 ; a reply to the recent article of Lundell (see *Digest*, June 20).—He refers to the experiments which are being made in Rome, N. Y., and points out errors in that article ; the claims of the Hardie motors are based on more than twenty years' experience ; that 300 cubic feet of free air will run an eight-ton motor one mile has been demonstrated by actual tests; he refers to recent tests made, of which some of the figures are given, showing that the differences of speed did not affect the resistance sufficiently to indicate with any accuracy on the ordinary gauges.

Direct-Feeding Systems. BELL. *St. Ry. Jour.*, July.—The fifth installment of his article on power distribution for electric railways ; he describes the different feeding systems.

Location of Trolley Wire on Curves. FOSTER. *St. Ry. Jour.*, July.—A description of a method when the wire is put over old-existing tracks of which there are no records.

Power for Motocycles. SUMMERS. *Elec. Eng'ing*, July.—Some computations of the weights and powers of such vehicles using different sources of power, including electricity.

Steep Grades on Electric Railways. FOSTER. *Eng. News*, July 9.—A long abstract of the paper noticed in the *Digest*, June 27.

Operating Statistics of Street Railways. St. Ry. Jour., July.—The first article of a series, giving comparative statistical information regarding the cost of operation of American street railways, based on the reports which have appeared in that journal.

Electric Railway Construction in Germany. MAGEE. *St. Ry. Jour.*, July.—An illustrated article describing some of the structural features, including a number of illustrations of ornamental poles.

Seashore Electric Railway. Cassier's Mag., July.—A short, illustrated description of the railway at Brighton, which was described in these columns last year.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central-Station Statistics for Germany. Elek. Zeit., June 25.—A large four-page table of statistics giving tabulated data for the year 1894-95; no summary is given.

Alternating and Direct High Voltage Supply. Lond. *Elec. Rev.*, June 26.—A summary and discussion of the papers read at the recent meeting of the Municipal Electric Association.

Municipal Control of Consuming Devices and Wiring. WORDINGHAM. Lond. *Elec.*, June 26.—A reprint in full with the discussion of the paper read before the Municipal Electrical Association noticed in the *Digest*, July 4 and 11.

Polyphase System of Ferraris and Arno. L'Eclairage Elec., June 13.—A brief description of a number of diagrams of this system (see *Digest*, June 6 and 13.)

Brighton. Lond. *Elec. Eng.*, June 26.—A plan showing the details of the extensions at this station.

Economical Heat, Light and Power Supply. GERDTZEN. *Bul. Univ. Wis.*, No. 9.—A very long article on this problem in connection with business blocks, school houses, dwellings, etc.; it is devoted almost exclusively to steam, coal and gas; a mere short reference to the electrical solution shows by some calculations that buildings cannot be heated economically by electricity except where abundant water power is available.

The Electricity Supply at 220 Volts. BARNARD. *Elec. Rev.*, July 8.—The beginning of a reprint in full of his Municipal Electrical Association paper.

WIRES, WIRING AND CONDUITS.

Calculation of Conductors. BOCHET. *L'Eclairage Elec.*, June 13.—An abstract of a recent paper, in which he shows a method of calculating the best cross-section of a conductor when the fall of potential is limited and the Kelvin law cannot be applied, as, for instance, in the distribution of incandescent lamps; the general solution is somewhat complicated; the abstract contains two simple examples; the ordinary method used is that based on a constant density; to show the advantage of the present method he takes an example and shows that the economy in copper is 33 per cent.

Loss of Voltage in Three-Phase Circuits. RASCH. *Elek. Zeit.*, June 25.—A reply to the criticisms of Heyland (see *Digest*, last week) with whom he does not agree; he shows where the latter was at fault.

ELECTRO-PHYSICS AND MAGNETISM.

New Form of Crookes Tube for Röntgen Rays. COLORDEAU. *L'Eclairage Elec.*, June 27; an abstract of a Physical Society paper.—Large tubes must be made of relatively thick glass to stand the mechanical strain, but the glass is not very transparent to the rays; experiments showed that the cathode rays act more energetically on the anti-cathode in proportion as the latter is nearer to the cathode; in the ordinary focus tubes this distance is several centimetres and is too great; a concave spherical cathode does not concentrate all the rays exactly at its centre, and this point varies with the degree of the vacuum, it being in general much further off than the centre of curvature. In order to overcome all these objections he constructed a tube in the form of a cylinder six to seven mm in diameter, containing a concave cathode of four to five mm radius of curvature, its diameter being slightly less than that of the tube; the anti-cathode is seven to eight mm from the cathode, and is inclined at an angle of 45 degrees; on the side of the tube opposite the anti-cathode the tube is blown into a small hemisphere, the thickness of the glass being only 0.1 mm; this apparatus gave excellent results, the sharpness of the images being unexcelled; with a large coil he obtained a detailed image of the skeleton of a finger in a second, and even instantaneous photographs; he also succeeded in making stereoscopic plates.

Photographic Action of Röntgen Rays. MAURAIN. *L'Eclairage Elec.*, June 20.—A brief description of some experiments to show whether the photographic action is primary or secondary; he used daguerreotype plates, increasing their sensitiveness by exposing them to the vapor of

bromium, and obtained no photographic impression whatsoever, which result was in favor of the hypothesis of secondary reaction; the same results were obtained in exposing one of these plate for six days to the radiations of nitrate of uranium, which before had given good results in a two days' exposure, using the ordinary plates.

Röntgen Radiation. Porter. Lond. *Elec. Eng.*, June 26; an abstract from *Nature*.—In comparing the results obtained by different observers, it seems important that the exact temperature should be given; any arrangement by which a charge on the outside of the tube behind the cathode would be subject to intermittent removal, greatly increases the fluorescence on photographic action, and also prevents the fatigue of the tube; to accomplish this a ring of copper wire is earthed and is placed so as to nearly touch the glass tube.

Röntgen Photograph of a Whole Human Body. Elek. Anz., June 25.—A statement that Wehrsen, in Berlin, obtained the skeleton of a complete human being; it was done with a Wimshurst machine, with discs 55 cm in diameter, costing only about $40, which shows that costly apparatus is not necessary; the life-size photograph is exhibited at the present exhibition in Berlin.

Radiographs of Articles. Cosmos, April 18.—A note with an illustration describing the results obtained by injecting in the arteries of a cadaver a paste of sulphate of chalk, sufficiently liquid to penetrate into the smallest branches; after hardening, a radiograph is taken, being careful to hold the tube at a great distance so as to have the shadows sharp; the sulphate of chalk is more opaque even than the bones, and the arteries are all shown quite black.

Artificial Blende as a Source of Röntgen Rays. Troost. *Comptes Rendus*, 122, page 564; abstracted in the *Proc. Lond. Phys. Soc.*, June.—He found that artificial hexagonal blende, after being acted upon by sunlight or magnesium light, will act like a Crookes tube as a source of these rays.

Discharge of Electrified Bodies by Röntgen Rays. Perrin. *L'Eclairage Elec.*, June 20.—A description of some experiments which he thinks show the nature of the mechanism of the discharge.

Röntgen Ray Literature. Proc. Lond. Phys. Soc., June.—A large number of abstracts of recent articles, all of which have been noticed, though some of them more briefly, in the *Digest*.

Cathode Rays and X-Rays. S. P. Thompson. Lond. *Elec.*, June 26.—He obtained the following results: With the usual tube, having an oblique plate of platinum, he found that when an aluminum wire projected into the path of the X-rays in the tube (that is, after the reflection), two shadows were produced when the exhaustion was sufficiently high, one of them being an X-ray shadow on a luminous screen, and the other a cathode ray shadow on the glass wall of the tube; both were thrown from the reflector as the origin, but while the cathode-ray shadow could be deflected magnetically or electrically, the X-ray shadow could not, even though this wire were electrified positively or negatively; at no state of exhaustion did the reflector convert all the cathode rays into X-rays.

Absorption of Cathode Rays. Lenard. *Wied. Ann.*, 56, page 255; abstracted in the *Proc. Lond. Phys. Soc.*, June.—A quantitative research of a large number of gaseous and liquid bodies; he found that approximately the ratio between the absorptivity and the density of all media is approximately equal to one and the same constant for a given kind of cathode rays; the final values are given in a table in the abstract.

Cathode Rays and Kinetic Theories. Leray. *Cosmos.*—A series of articles of a theoretical nature appearing in successive issues in June.

Fluorescence of Solids and Solid Solutions. Wiedemann and Schmidt. *Wied. Ann.*, 56, page 201; abstracted in the *Proc. Lond. Phys. Soc.*, June.—It deals with an elaborate series of experiments, the chief results of which are summarized in that abstract.

Electrophotography. Robinet and Perret. *La Nature*, May 9.—An illustrated description of an experiment in which a plate, presumably a negative of some photograph, was placed with its gelatine side against the gelatine side of an ordinary sensitive plate and the whole placed in a dark box with a conducting plate at the top and another at the bottom, insulated from each other, and connected to the two poles of an induction coil of 7 to 10 cm spark length; after about 30 minutes the plate was developed and found to contain a very fine image of the picture in the negative; the details were said to be very fine and the shadows were not quite as dark as on the usual photographs; the impression was a very soft one. It does not seem to depend on the time of exposure but is greatly affected by the intensity of the current which is a function of the frequency, as also on the kind of metallic plates forming the condenser and on their distance apart; they find that phosphorescence takes no part in this action; they suggest that it might be due purely to the action of the electric waves themselves.

Photo-Galvanography. Piljtschikow. *Elek. Zeit.*, June 18.—Under the action of light the copper deposit in a Daniell cell is increased; he uses this principle in a photographic camera in which a small glass tank replaces the sensitive plate, the image being thrown on the copper pole of the Daniell cell in this tank; it is thought possible that illustrations for printing purposes might be thus produced; the invention is not to be patented.

Electric and Magnetic Research at Low Temperature. Fleming. Lond. *Elec. Eng.*, June 26; the conclusion of his recent lecture (see *Digest*, last week).—He continues the discussion of the behavior of magnetic metals; among other things he found that the change of an alloy into the magnetic variety is accompanied by an increase in conductivity; all alloys having a negative temperature coefficient are probable instances of the same mode of variation of resistance. He discusses the subject of the absolute zero of temperature showing that any pure metal at this temperature would become a perfect screen for electromagnetic radiation and would be perfectly impenetrable to electromagnetic induction; an experiment illustrating this is described; the absolute zero of temperature might be defined as that temperature at which perfectly pure metals cease to have any electrical resistance; he discusses what the function of the conductor is under these conditions, stating that these experiments are another important link in the chain of evidence which compels us to look for the processes concerned in the conveyance of energy by an electric current, not inside the conductor but in the dielectric or medium outside; this is discussed theoretically. He shows that in passing from the liquid to the solid state there is generally an immense increase in the conducting power of metals; the results for mercury are given, there being a sudden four-fold increase between 41 and 36 degrees C. Experiments with bismuth are described (see *Digest*, July 4); regarding the action of carbon he finds that in the form of an incandescent lamp filament it increases in resistance as the temperature is lowered, but the rate is slow; all the so-called insulators also increase in resistance as the temperature is lowered. The subject of thermo-electric cables is discussed at some length; the lines are by no means all straight, in many of them there is a decided tendency to bend around, indicating that the thermo-electric power would probably become zero at the absolute zero of temperature. The subject of the magetization of iron at low temperatures is then discussed (see *Digest*, June 20); among other things he states that one of the best ways of ageing a magnet is to plunge it several times into liquid air; hard iron has its permeability greatly increased by cooling it, the change taking place with great suddenness; the theory of magnetization is briefly discussed.

Electrical Resistivity of Bismuth. Fleming. Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, June 26.—Copy of a short letter sent to the Royal Institution by Profs. Dewar and Fleming, reprinted in The Electrical World last week. In an editorial comment in the *Elec.* it is stated that as the resistance line of bismuth points toward the absolute zero, this, together with the increase in resistance due to the magnetic field, would appear to indicate that pure bismuth, which is a perfect conductor at absolute zero, could be converted at that temperature into a perfect insulator if placed in a sufficiently strong magnetic field.

Electrical Resistance of Alloys. Lord Rayleigh. Lond. *Elec.*, June 26; reprinted from *Nature*.—A short article pointing out the difference between the behavior of pure metals and of alloys at low temperatures, the resistance of the former tending to disappear at absolute zero, while with the latter it is quite different; he then suggests that the apparent resistance of an alloy might be partly made up of thermo-electric factors; a calculation which he carries out on this basis affords a ground for the supposition that an important distinction may exist between the resistance of pure and alloyed metals.

Resistance of Manganine.—See article under *Potentiometer* by Fisher

Electric Current in a Conductor. Silberstein. *Electrochem. Zeit.*, June.—An article of a theoretical nature showing that a consistent conception is possible of an electric current in conductors on the basis of Maxwell's theory and that this has been done by Poynting, of whose articles he gives a summary.

Electric Resonance. Domalip and Kolacek. *Wied. Ann.*, 57, page 731; abstracted in the *Proc. Lond. Phys. Soc.*, June.—An experimental and theoretical investigation of the variations of electric tension at the ends of a secondary coil when the primary is in the discharge circuit of a Leyden jar, as in Tesla's experiments; they are lead to the conclusion that the electric processes at the poles of the secondary circuit are very variable and the conditions of the passage of the spark are not static; the sparking distance depends only on the voltage and not on its variations in time.

Electric Oscillations. Planck. *Berl. Berichte*, 9, page 151; abstracted briefly in the *Proc. Lond. Phys. Soc.*, June.—He considers the subject mathematically on the basis of Maxwell's general equations.

Electromagnetic Theory of the Inertia of Matter. Lond. *Elec.*, June 26; an editorial note on the recent theories of Houston and Kennelly, published in The Electrical World, June 6, p. 672. It is thought improbable that the hypothesis would stand a close quantitative examination, and that the mystery which surrounds the inertia of matter is not appreciably dissolved by a hypothesis so much in conflict with known facts.

Velocity of an Electromagnetic Disturbance. Blondlot. *Ann. Chimet. Phys.*, 7, page 442.—With the aid of rotating mirrors and of photography he determined the velocity along two long wires, obtaining an average velocity of 297,100 kilometres per second.

Earth Currents at Vesuvius. Palmiere. *L'Eclairage Elec.*, June 6.—A short article, giving the observations during 1895, on an inclined line from the observatory to the base.

Apparent Viscosity of Dielectrics. HESS. *L'Eclairage Elec.*, June 6.—He discusses the researches of Arno, and concludes that if there can be a molecular viscosity in dielectrics, it is certain that in a composite dielectric, one of whose constituents has conductivity, such viscosity is always produced in such a transformation of energy.

Dielectric Resistance. DRUDE. *L'Eclairage Elec.*, June 6; translated from the *Wied. Ann.*, Vol. 57, page 223.—He proposes the use of this term as an analogy with magnetic resistance; the article is of a theoretical nature.

Thermo-electric Couples. VAN AUBEL and PAILLOT. *Arch. Sc. Phys. et Nat. Genève*, 33, page 149.—Results of measurements of the E. M. F. of constantan with iron, aluminum and manganin.

Thermo-Currents. MEWES. *Electrochem. Zeit.*, June.—He endeavors to explain the existence and production of such currents on the basis of his undulation theory (see *Digest*, Sept. 21, Dec. 28 and Jan. 25 under the name MEYER).

Iron Spheres in Homogeneous Magnetic Fields. GROTRIAN. *Elec. Zeit.*, June 25; abstracted from *Wied. Ann.*, Vol. 57, page 751.—He describes experiments made to show the existence of homogeneous magnetization; a number of coils were placed on the surface of the iron sphere perpendicular to the magnetic axis, the whole being placed in a solenoid; the results showed that in such spheres of soft iron the entrance of the lines from the air into the iron is in accordance with the theory of the homogeneous magnetization of a sphere.

Lines of Magnetic Induction. POTIER. *L'Ind. Elec.*, June 25; *L'Eclairage Elec.*, June 6, 13; *L'Elec.*, June 20; a continuation of the discussion at the French Academy regarding the new theories of Deprez; a reply of some length by Deprez is reprinted in *L'Ind. Elec.*, June 26; *L'Eclairage Elec.*, June 13, and *L'Elec.*, June 27.

Magnetization of Crystallized Magnetite. WEISS. *L'Eclairage Elec.*, June 13.—The first part of a very long article describing experiments and giving the results of measurements.

A Feature of X-Ray Radiation. TESLA. *Elec. Rev.*, July 8.—A short article describing some observations which he thinks may throw some light on the nature of these radiations; they agree with his views that the rays consist of streams of minute material particles; this matter may come from either of the electrodes, and more probably consists of parts of the electrodes rather than of the residual gas; by impact this matter is further disintegrated into particles sufficiently minute to pass through the glass; an impact and consequent shattering seems absolutely necessary for the production of the rays; the vibrations can only be longitudinal; the principal source of the rays is the place of the first impact within the bulb. He gives an illustration of a cylindrical tube containing the cathode at one end, while the anode consists of a platinum sheet in the form of a truncated cone or funnel with its smaller end pointing outwards, the object being to find out whether the rays generated at the inner surface of the platinum funnel would be brought to a focus outside of the bulb; the apex of the cone was a point about two centimetres outside of the bulb; when in action, a phosphorescent ring was formed on the tube opposite the small end of the funnel and a fluorescent screen placed at successive distances showed that the rays were all focused to a point representing the apex of the cone, and from here they proceeded in straight lines forming on the screen a bright ring; the fluorescent glass wall emitted practically no rays; with a weak excitation of the bulb, the edges of the dark circle were very sharp, which speaks strongly against diffusion.

Röntgen Rays and Optically Active Substances. FRANKLAND. *Nature;* reprinted in the *Elec. Eng.*, July 8.—He refers to a recent article by Prof. J. J. Thomson, in which it was suggested that the leakage of electricity through non-conductors under the influence of Röntgen rays is due to a kind of electrolysis; the present writer states that if such ionization takes place, independent evidence of it should be obtainable in the case of optically active substances by a change in their rotary power when exposed to X-rays; he made some experiments which showed that there was not the slightest change in the rotation, from which he concludes that Röntgen rays either do not give rise to any ionization or that the concentration of the ions is so small that it cannot be detected.

Are X-Rays Odylic Rays? O'REILLY. *Elec. Eng.*, July 8.—He quotes from a book by Reichenbach, published in 1846, on the subject of odyle; it appears that this has polarity, is caused by heating, has an existence independent of magnetism or electricity; can be conducted by a wire, but much more slowly than electricity and faster than heat, and that it can pass through solid matter. He sees in the fluorescence of the X-ray tube the same phenomena as are caused by odyle.

Dr. Partz, in a Philadelphia daily paper some months ago, also called attention to this "odic" force, which Reichenbach claims to be the vital force of nature; it appears that this "od" could unfortunately be perceived only by persons of a certain sensitiveness; his theories were ridiculed at the time; an experiment was made with a large electromagnet in a dark room; when the current was turned on with the knowledge of the observers, several persons present saw a bluish light at the poles of the magnet, some a glow and some a flame; Partz had some personal experience with this force, and has proof of its radiation through leather and several sheets of paper; he, therefore, associated it with the X-rays, and believes there is a close relation between the two forces if they are not identical; he proposed (in February) making an experiment with a sensitive plate, having objects placed on it and itself placed on a magnet, and thought it highly probable that impressions would be obtained (which, as was shown some time ago in these columns, is actually the case).

Photometer for Röntgen Rays. MESLIN. *Elec. Eng.*, July 8; abstracted from the *Jour. de Physique.*—The principle on which it is based depends on the comparison of the brilliancy of two halves of a circular patch, one half of which is rendered fluorescent by Röntgen rays and the other by the light rays from some standard source after being passed through colored glass to give it the same tint; with this he has verified the law that the intensity varies inversely as the square of the distance.

Darkening of the Cathode in a Crookes Tube. CAJOI and STRIEBY. *Science*, reprinted in the *Elec. Eng.*, July 8.—They noticed that the glass about the anode and that opposite the cathode became darkened after long use and a pencil of faint bluish light emanated from the circular area of the disc inside the dark ring, this pencil being normal to the disc.

Cause of Continuous Spectra in Exhausted Tubes. BIRCHMORE. *Elec. Eng.*, July 8.—An article describing what he calls a remarkable phenomena which led him to the conclusion that the light produced is not emitted by the gases; he obtained a continuous spectrum and offers a suggestion as to its origin.

Electric and Magnetic Research at Low Temperatures. FLEMING. *Elec. Eng.*, July 8.—The beginning of a reprint, apparently in full, of his recent lecture, abstracts of which have appeared in these columns.

ELECTRO-CHEMISTRY AND BATTERIES.

Accumulator. Lond. *Lighting*, June 11.—A brief, illustrated description of the Elieson "Lamina" accumulator. It is of the Planté type, and has a large surface; a lead strip is punched with 50 holes to the square inch, and is then corrugated with about eight corrugations to the inch; this is cut into the sizes for the various plates; a number of these sheets, generally about nine, are placed one over the other with their corrugations alternately vertical and horizontal; the inner sheets are 0.012 inch in thickness; they are riveted together and have a lug fused on the top; they are then formed by a secret process requiring 72 hours. Tests made by that writer showed a capacity of 74 ampere-hours at a discharge rate of 20 amperes, which is said to be the maximum rate; at 10 amperes the efficiency in ampere-hours was 81, and in watt-hours 69 per cent.; the weight was 24 pounds 5 ounces complete, and the capacity at this rate was 4.4 amperes per pound of lead, or 3 per pound of cell complete.

Theory of the Lead Accumulator. LIEBENOW. *Zeit. f. Electrochem.*, June 20; a second installment of his article (see *Digest*, Feb. 8).—In his former article he showed how the process in an accumulator may be explained in a simple way under the assumption of the existence of negative lead peroxide ions; in the present portion he shows the existence of these ions.

Electrolytic Method of Making Welsbach Mantles. *L'Elec.*, June 27.—A process which was patented to Langhaus in Germany, which consists in mixing with the nitrates or sulphates of the earthy metals used the salts of the earthy bases, forming an electrolyte, through which a current is passed onto a skeleton of woven, fine, platinum wire, shaped like the mantle; on this the metals are thereby deposited and are afterwards calcined; the mantles are said to be strong and the selling price of the whole mantle including the burner and the chimney does not exceed 50 cents; after the oxides have been consumed the skeletons can be re-covered.

Purifying Oil and Fat. SIEGROTH. *Electrochem. Zeit.*, June.—A brief description of the ASPINVAL, HOAR and WISE system; in the treatment, for instance of a vegetable oil, it is placed in a vessel divided into two parts by means of a diaphragm, the oil being placed in one of them mixed with a salt solution to make it conducting, while the other portion is filled with a plain salt solution; the positive electrode is of carbon which is in the salt solution, and the negative of copper; the voltage is at least six; it may be heated to 82 degrees C. to drive out the chlorine (from which it appears that the salt used is probably chloride of sodium); diluted sulphuric acid may be used in place of the salt solution; it is stated that the light and heat of the arc can also be used when generated in the oil.

Polarization and Resistance of Galvanic Cells. STREINTZ. *Elek. Zeit.*, June 25.—An abstract of an article from an Austrian journal showing the possibility of measuring galvanic polarization; he shows that the idea of an ohmic resistance of a cell which polarizes, should no longer be held, and that the calculation of the polarization based on the internal resistance can lead to no useful results.

Polarization of Thin Metallic Membranes. LUGGIN. *Wied. Ann.*, 57, page 700; abstracted in the *Proc. Lond. Phy. Soc.* June. Experiments were made with thin gold leaf placed between perforated plates of mica; the results are in good agreement with the view that the conductivity is mainly due to the liquid filling in the pores of the metal.

New Method of Preparing Alloys. MOISSAN. *L'Ind. Elec.*, June 25.—He obtained alloys of aluminum with most of the refractory metals. A mixture of the oxide to be reduced and aluminum filings, is placed in a

bath of melted aluminum; the combustion of a part of the aluminum in the air at the surface produces such a quantity of heat that the oxides of the most refractory metals are reduced thereby; he thinks that the method can be used for producing a large number of new alloys.

Electric Treatment of the Minerals at Broken-Hall. Andreoli. *L'Eclairage Elec.*, June 13 and 27; a continuation of his article (see *Digest*, June 13).

Vanadium. Moissan. *L'Eclairage Elec.*, June 25.—An abstract of an Academy paper describing the preparation of this material and its carbide in the electric furnace; the acid is reduced by the carbon; it is easily prepared in quantities; if heated long the carbide is produced.

Molybdenite. Guichard. *L'Eclairage Elec.*, June 20.—An abstract of an Academy paper describing experiments showing that this material can be easily produced in a melted and pure condition in the electric furnace, from its sulphide; the material is used for making steel.

Electro-Chemical Instruction. Oettel. *Zeit. f. Electrochem.*, June 20.—An article on the instruction on this subject at the chronological schools.

Electrolysis of Chlorides. Andreoli. *Eng. & Min. Jour.*, June 20; the conclusion of his serial (see *Digest*, June 27).—He describes the Castner process, which he considers far superior to the Richardson and Holland; mercury is used, not as a cathode, as is generally believed, but as a diaphragm; stress is laid on the absence of hypochlorite, which is a serious drawback in the other process; his anodes are made of retort carbon submitted to a very high temperature in contact with different substances; a brief description of his plant at the Aluminum Company's works is given. He then describes a third method, the Hargreaves, based on the use of porous partitions on each side of the positive compartment, and of the two dry negative compartments; a yield of 92 per cent. is obtained; the Le Sueur process is briefly referred to, but the results, it is claimed, do not bear comparison with the others. According to Hargreaves it is better from a commercial point of view to make carbonate of soda than caustic soda. An estimate for a 2000-hp plant based on the works at Farnworth is given. Each of the three processes are absolutely different from each other, and he considers it an accomplished fact that they have solved the problem commercially; electrolysis can compete with the chemical methods, as far as purity and cheapness are concerned, and it is far superior as regards simplicity of installation, besides being more sanitary; the Hargreaves process promises to be the cheapest.

Electrolytic White Lead. Orne. *Eng. & Min. Jour.*, June 27.—He refers to the recent article (see *Digest*, May 30) claiming that the statements are quite contradictory and the reactions quite different from those given in standard works on chemistry; he shows that nitric acid is constantly being destroyed and that the solution becomes alkaline, thus requiring something to render it neutral.

Aluminum Works at Niagara Falls. Dunlap. *West. Elec.*, July 11.—An illustrated description of the electrical equipment of these works, including illustrations of the rotary converters. This company will soon be turning out 10,000 pounds of aluminum a day; the total output of this metal in the United States for 1895 was 850,000 pounds.

Direct Production of Electricity from Coal. Stockbridge. *Eng. Mag.*, July.—An article giving a brief history but devoted mainly to a description of the Jacques cell, which is praised very highly; the fact that one critic (see The Electrical World, June 6, p. 669) has asserted that it is nothing more than a good thermo-electric battery, is mentioned but not replied to.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Magnetic Units. Blondel. *L'Eclairage Elec.*, June 20.—An article discussing the subject in general, showing the importance of arriving at some conclusions, and indicating a solution of the question which he thinks meets best the needs of practice. He discusses the absolute system, the one suggested by the American Institute and that proposed by the British Association; the former is perfectly rational and meets the requirements of the physicist but not those of the practical engineer, as the calculations of the machines and apparatus is uselessly complicated by the necessity of having constantly to change from the practical to the absolute system or the reverse; in the discussion of the system of the American Institute he states among other things that in reality permeability has dimensions but although they are unknown it is not permissable to consider $\mathfrak{B}$ and $\mathfrak{H}$ to be the same kind of a unit; he considers the system clear and logical, although it has its faults; he does not favor the British Association system, which he discusses at some length; some of the propositions he does not think could be accepted and among other things states that there is a confounding of the nature of the quantity with its physical dimensions; two quantities having the same dimensions are not necessarily equal, and making them so creates confusion, as for instance, according to the theory of Gauss, a pole of one weber produces a flux of 4π webers; or a coil of 10 windings of which the magnetic circuit has a permeance of 10 henrys, has a self-induction of 1257 henrys; to be logical, magnetomotive forces should then be expressed in amperes; this shows that the unit of permeance is itself different from self-induction; he discussed the definition of the unit of self-induction which was adopted at the Chicago Congress; he does not approve of it, as compared with the usual definition, because the quantities thus defined are totally different when there is iron in the circuit; he prefers calling the quantity as defined at the Congress, reaction or self-reaction; in this English system he approves of making the unit of flux equal to 10^8 C. G. S. units and of measuring the magnetizing force or the intensity of a field by the fall of the magnetic potential along the line of force in gausses per centimetre, instead of adopting a special name. He then proposes a system which he thinks preferable and the only logical one; it consists simply in completing our practical system of electrical units, preserving a perfect coherence throughout; it will probably be necessary to use new names, and he therefore proposes the following: for the practical unit of flux, the maxwell (or weber) equal to 10^8 C. G. S. units, because the volt is equal to 10^8 C. G. S. units; for the practical unit of difference of magnetic potential (gaussage), the hertz (or grauss) equal to 10^{-1} C. G. S. units or $\frac{1}{4\pi}$ ampere-turns, as the ampere equals 10^{-1} C. G. S. units; these two units would suffice in practice, but in order to preserve the analogy with the electric circuit it would be well to adopt a practical unit of reluctance equal to the ratio of the two preceding, that is, to the hertz divided by the maxwell, therefore equal to 10^{9} C. G. S. units, and this he proposes to call the arago (or oersted); for the reciprocal of this, representing permeance, the reverse name might be used, that is, ogara, and this would be homogeneous with the henry; induction would then be measured by the fall in hertzes or gausses per centimetre of length of a line of force. All the objections to these units he thinks can be met by using multiples and sub-multiples of these units; induction would then be represented by microwebers per square decimetre; an induction of 16,000 C.G.S. units would then be in induction of 16,000 microwebers per square decimetre; the unit of self-induction would then be the weber per ampere, and the unit of self-reaction would remain the henry as defined at Chicago, as equal to one volt-second per ampere; permeability as referring to air, would remain a number and therefore require no unit and its reciprocal is of no interest. This would complete a practical system which would answer all purposes without having any resort to the C.G.S. units. He then discusses the question of the 4π factor, as also "the rational" system of Heaviside, which however he does not favor partly because this factor does not disappear, being simply transferred to another place; he does not claim any originality in the system proposed by him.

The Crompton Potentiometer. Fisher. Lond. *Elec.*, June 26; a continuation of his series of articles (see *Digest*, May 23).—The present portion is devoted entirely to the subject of manganin; he gives the results obtained by a number of authorities showing its resistance curve for different temperatures; he claims that there is no difficulty in constructing reliable standards of this material if it is properly and consistently treated, provided it all comes from the same source; he shows that there is a decided difference in the curves of samples taken from different sources; one of his curves shows the changes during the process of annealing and ageing; manganin is not easy to solder but the difficulty disappears entirely if it is first gilded. He gives a description of a set of ratio coils for use with the potentiometer.

High-Resistance Measurements. Grosselin. *L'Eclairage Elec.*, June 13.—A reprint of a short paper showing that in the method described by Picou (see *Digest*, July 4) the capacity of the cable itself is generally neglected (in this test a short piece of the cable is connected through its insulation with a condenser in series, the latter being charged by the leakage current which is then measured by discharging the condenser after a certain time); he shows that if the capacity of the cable be neglected, the results will be quite incorrect, the insulation resistance obtained being much too small; this cause of error can be eliminated by making two tests of the same cable for different intervals of time; the method also supposes that the insulation of the condenser is perfect, which introduces a second cause of error which can be eliminated; he therefore prefers the ordinary loss-of-charge method, which is much more rapid and more exact.

Measuring Potential and Dielectric Constants. Lombardi. Lond. *Elec.*, June 26; a brief abstract of a paper in the annual report of the Zurich Physical Society.—Thin rods or plates of a conducting or dielectric substance when placed in a homogeneous electric field, are subjected to a couple tending to place their greatest diameter parallel to the lines of force; the forces can be calculated for the case of an elipsoid; he shows that differences of potential may be accurately determined by this method. In a paper by the same author in *Elettricista*, also briefly abstracted, he shows how capacities of condenser are measured by the means of sinusoidal alternating currents.

A New Lorenz Apparatus. Lond. *Elec.*, June 26.—An illustrated description of an apparatus made by Nalder Bros. for the McGill University, Montreal, under the supervision of Prof. Jones, for the determination of resistance in absolute measure according to the Lorenz method.

Curve Tracer for Alternating Currents. Drexler. *Elek. Zeit.*, June 18.—An illustrated article describing the method, which was noticed in the *Digest*, May 23.

Apparatus for Testing Lightning Rods. *Elek. Anz.*, May 31 and June

4.—A description of an apparatus for testing the condition of lightning rods.

Electrochemical Actinometry. MARECHAL. *Proc. Lond. Phys. Soc.*, June.—An abstract of his recent series of articles (see *Digest*, April 25). The Lond. *Elec.*, June 26, also publishes an abstract of these articles.

Thermophone. PULUJ. *Zeit. f. Elek.*, June 15.—A short reference to the apparatus of Warren and Whipple (see *Digest*, Nov. 30, June 6) for measuring the temperature at a distance, accompanied by a statement that an apparatus identical in principle was constructed by him in the year 1889 and called a telethermometer.

Capillary Electrometer. VIGOUROUX. *L'Elec.*, June 27.—An illustrated description of an instrument which he used in electro-therapeutic work.

Calibration of the Slide-Wire Bridge. BENECKE. *El'ty*, July 8.—An illustrated description of a simple method which can be carried out with the aid of only such appliances as will be found in any laboratory. Four resistances are connected in series with each other and with the bridge wire, forming the closed circuit of a Wheatstone bridge, the galvanometer being connected to the junction of the second and third resistance and to the sliding contact, while the battery is connected between the junction of the first and second and that of the third and fourth resistances; by moving the sliding contact until the deflection is zero, then interchanging the four resistances and again finding the neutral point, a certain relation hold true, from which the resistance of a portion of the slide wire may be calculated, and therefore the resistance of one scale division; this portion of the bridge wire, whose value is to be determined, can easily be shifted over the whole length by a suitable selection of the other resistances.

Graduation of a 100-Inch Photometer Bar. SMITH. *Tech. Quart.*, March.—A table of scale readings in inches and the corresponding ratios, which, when multiplied by the value of the standard, gives the value of the unknown; it is preceeded by a description of the method by which it was calculated by the use of labor-saving tables.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Protection of Telephone Lines from the Influence of Strong Currents. MATTAUSCH. *Zeit. f. Elek.*, June 15.—An illustrated description of a method for preventing the effects of induction from neighboring lines carrying strong currents; the device is placed at the central station, and enables a common return earth wire to be used by a number of subscribers without running any risk that one subscriber can hear the conversation of another; the description is not quite clear; the apparatus is said to work well.

Military Telegraphy in Italy. MONTILLOT. *L'Elec.*, June 13; a continuation of his article.—He gives the rules for the construction and for the taking up of a line.

Horizontal Multiple Switchboard. ZIELINSKI. *Elek. Zeit.*, June 18.—An illustrated description with the details of a board made in Germany.

Inductance as a Negative Capacity in Submarine Cables. DAVIDSON. *Elec. Eng.*, July 8.—A detailed description of experiments showing the value of inductance as a negative capacity, which were made on a submarine cable; they are only of qualitative value, and as such show that inductance tends to nullify a distributed capacity, although not completely, owing to the great difference between the electromagnetic and the electrostatic time constants of the circuit.

MISCELLANEOUS.

Calcium Carbide in Agriculture. Cosmos, June 13.—A note stating that CHUARD experimented with this material, small portions of which were placed in the earth near the roots of plants; under the influence of moisture the carbide decomposes slowly, developing acetylene around the roots and developing at the same time chalk and a small amount of ammonia, all of which are beneficial to the soil; he proposes also to use it as an insecticide in connection with plants both on their leaves and at the roots.

Manufacture of Calcium Carbide. Lond. *Elec.*, June 26.—An abstract of a recent article describing the manufacture of this material at Froges; it contains no estimate of cost.

Electrically Operated Compass. Elek. Anz., June 28.—An illustrated description of the HECKER system for steering ships.

Electrical Igniter for Gas Engines. HAMERSCHLAG system. *Elec. Eng.*, July 8.—An illustrated description of a system the main purpose of which seems to be to obtain a simultaneous explosion in two or more cylinders; the novelty appears to lie in causing the spark to be produced in the cylinder by the piston itself, which closes a contact with an insulated terminal at the end of the cylinder.

Municipal Electrical Association. Elec. Eng., July 8.—A brief summary of the proceedings, with short abstracts of the papers.

Australia as a Field for Electric Supply. DAWSON. *Elec. Eng.*, July 8.—A reprint of an article noticed in the *Digest*, July 4.

New Book.

HOW TO MAKE AND USE THE STORAGE BATTERY. By P. Warwick. The Bubier Publishing Company, Lynn, Mass. Illustrated; Price $1.50.

Considering the extent to which the exponents of the storage battery have availed themselves of the scientific press of this country, to exploit periodically this form of storage apparatus, it has been a cause for wonder that no American book has appeared treating this subject in a manner compatible with its importance and the awakening interest felt for it on every side. Wonderment will now be annulled by the fact that a small handbook under the above caption has recently appeared. It is to be regretted that while the scope of the subject is so large the breadth of the author should be so small and that a treatise on this subject should be written in a way altogether uncommensurate with its importance.

Mr. Warwick's book professes to teach the tyro in electricity how to make use of a storage battery, and embraces the history, theory, maintenance and installation of accumulators. While such an aim might be carried out in an octavo of 130 pages, it is certainly not accomplished in the volume before us. What strikes one on reading the treatise is the tendency of the author to skim along the surface of his theme and to intermit this process by passing off into digressions that are not in any way pertinent to the subject. Chapter 7, on "How to Install, Work and Maintain a Storage Battery Plant," devotes 12 pages to the question at issue and 36 pages to irrelevant matter, *i. e.*, to descriptions of electrical units, to tables for the conversion of measures of length and volume, to statements of the occurrence of lead ores, their smelting and refining, to tests for copper and silver in lead, to descriptions of the different oxides of lead, and lastly to a statement of the methods of manufacturing sulphuric acid. What all this has to do with the storage battery one is at a loss to know. Chapters 5 and 6, on "Modern Types of Batteries," and "Lead, Zinc, Copper, Alkaline and Other Storage Batteries," state categorically the facts as they exist. Such a statement, however, is not desirable in a handbook on this subject. No busy electrician cares to know about the complete evolution of the storage battery, but rather about the few good modern types of accumulators in successful operation. Chapters 1 and 2, on the discovery and the theory of the lead-lead peroxide couple are treated in a very disappointing way.

It is undeniable that a good treatise on the storage battery would be a boon to the practical electrician, and would be of no little interest to the student and the layman. Such a book, prepared for busy men, would be, first of all, practical. It would deal with the physics and chemistry of lead cells in such a way as to be a guide to the reader in selecting and using storage batteries for a given end. It would embrace a comprehensive statement of the accessory apparatus which forms so important a part in all accumulator installations. It would treat in detail the various applications of storage batteries in central lighting stations, in power stations, in isolated plants, as a substitute for primary cells, etc., etc., etc., such descriptions being accompanied by profuse illustrations, showing method of connecting in battery in such installations. Lastly, practical instruction on the setting up, care and operation of accumulated cells, would consume sufficient space to militate against the introduction of extraneous, *i. e.*, irrelevant matter. With the great scope that a really practical and valuable book on storage batteries would have, it is almost inexplicable that Mr. Warwick should have been in such slight sympathy with his subject. The mere consideration of the theme, and the recognition of the needs of the practical electrician ought to be enough to stimulate a writer to the very best of endeavors. There is hardly any excuse for the meagre way in which Mr. Warwick has treated his subject.

A Successful Telephone Construction Company.

The Western Telephone Construction Company, Chicago, was incorporated in 1892. It began putting high-class telephone apparatus on the market, and has since continued so doing. Realizing the necessity for non-infringing apparatus the company perfected a compound magneto, transmitter and receiver, which at the expiration of the broad Bell patent was placed before the public. These instruments and the company's switchboard continued to grow in favor until late in 1894 when the company began manufacturing microphones.

Since then the growth of the company has been rapid, there being an average increase in the output each year of about 500 per cent. of that of the previous year.

This company protects its manufactured products against infringement, and enters into contracts with purchasers to assume the defense, at its own expense, of any suit or suits brought against them.

Its apparatus throughout have many points of originality and merit. The peculiarity of the switchboard is that the drop is directly in front of the spring jack, and covers the latter completely when down. The operator in answering a call pushes a plug against the fallen drop and into the jack. The drop is thus mechanically restored and the connection made with the line by the one movement of inserting the plug in the jack.

An entirely new system of inter-connection between boards has been invented and perfected by this company and is now being installed in three of the largest independent exchanges in the United States, viz.:

those of Richmond, Va., Fort Wayne, Ind., and La Crosse, Wis. An excellent feature of this system is that it can be added to, to any extent, without re-designing and re-constructing the apparatus already installed.

Shunt Coil for Electro-Therapeutic Apparatus.

In order to meet the demand for an instrument that will enable electro-physicians to utilize electric light current in their practice, such a device has been brought out by the Electro-Medical Company, Chicago. The instrument is called a shunt coil and is illustrated herewith. It was designed by Dr. R. V. Wagner and is constructed on the shunt principle for the purpose of regulating the voltage of the incandescent light current.

This instrument is designed to take the place of the ordinary rheostat, to graduate the voltage of the current to the proper limits according to individual necessity. The voltage is increased or decreased by units of two volts each, and it is stated by the manufacturers that this instrument is absolutely safe to handle. By this method of regulation there is no danger whatever to the patient, attending the use of electric light current in this manner. The instrument does away entirely with the use of batteries, and gives a practically uniform current.

Shunt-Coil.

The instrument shown includes a switchboard and case for the same. It has a slate base and is constructed in strict compliance with the rules and requirements of the Underwriters' National Electric Association. The switchboard is of hard rubber, mounted with a double selecting switch, pole-changers, binding posts and 36 buttons, representing 82 volts.

A New Pivotal Truck.

The accompanying illustrations represent the latest type of American passenger pivotal truck being introduced by the J. G. Brill Company, Philadelphia, Pa. The truck has a wrought-iron frame with jaws forged on, solid extension pieces, T-iron end pieces, angle-iron jaw straps and angle-iron transoms with spring-plank formed of two Z-pieces filled with wood. The equalizers are a part of the spring-plank carrying the swing-bolster and take their load in the centre. They are in turn carried by

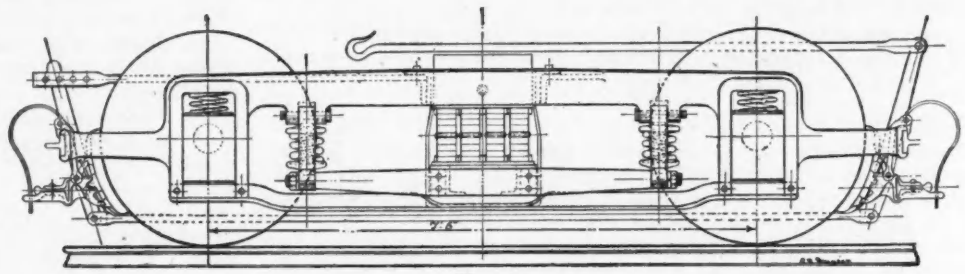


Fig. 2.

links and move with a swing motion. The vertical elasticity is furnished by eight-inch journal box springs, nest spirals in the links and triplet and quadruplet elliptics on the equalizer and spring plank.

The new features introduced are that the swing-links have springs and are outside of the wheels. They carry the equalizer bar, which in turn carries the spring plank, or an integral part of it. The equalizer is a straight bar with spring-suspension at the extreme ends, and at the centre of which the load is carried. There are three sets of springs in series, which carry the load, and motion from the journals is cushioned by

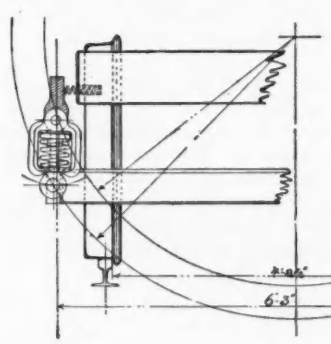


Fig. 3.

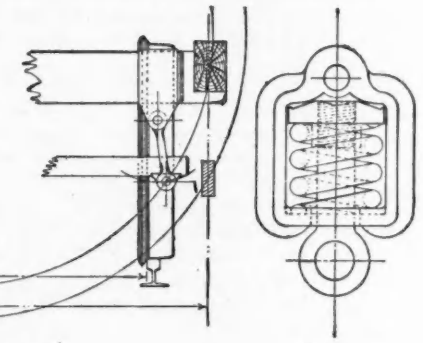


Fig. 4.

springs before reaching the equalizers. The elliptics, spirals of the spring-links and journal-springs are "in series," one set taking up motion while the other cushions shock. These features result in absorbing the side-thrust, by additional cushioning of the load in the spring-links, reducing the amount of weight on the axles, less noise and jar in stopping, less lifting action, cushioning of the side motion, reducing lifting car body when the wheel rises, economy of maintenance and ability to shorten wheel-base with the same space for motors on electric cars. The strains on the truck-frame for a given weight of car and load are said to be much less than in the ordinary construction. The swing-links come close to the pedestals, relieving the wheel-pieces from a large part

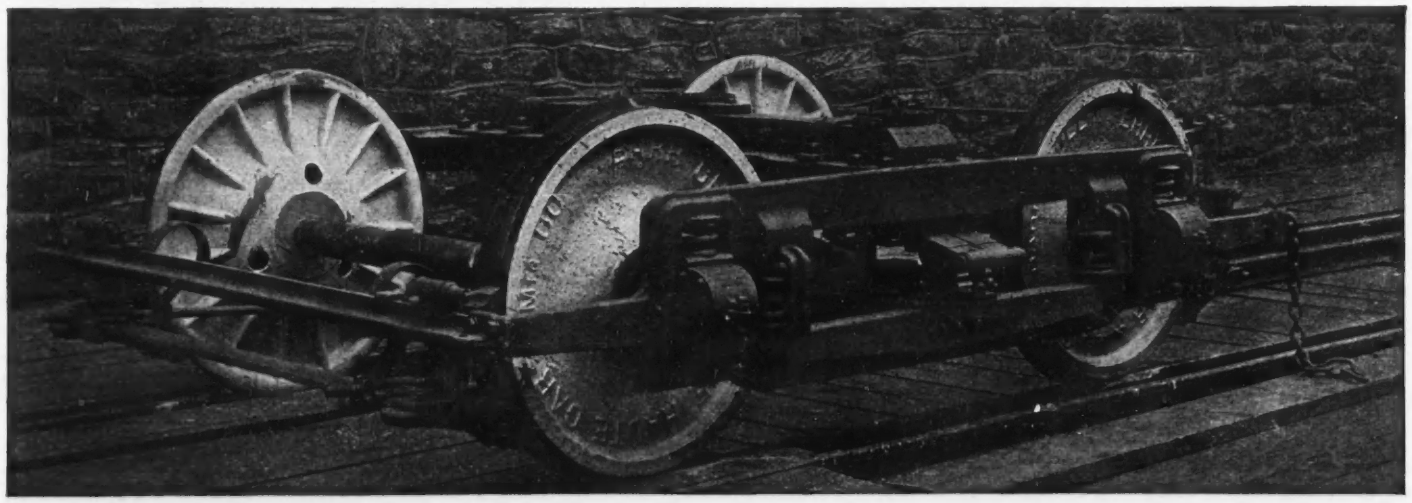


Fig. 1.

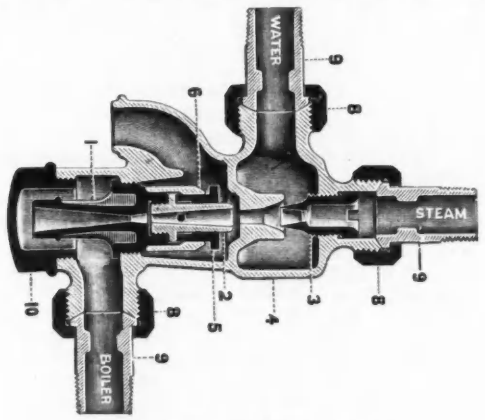
of the strain which comes upon them when the load is carried by the transom. Other things being equal, therefore, the truck may be kept square with a less strain on the frame. Fig. 3 shows the new style and the old style of swing motion. In both cases the centre-plate is taken as the centre of motion and support, the circles representing the lines of motion. With the old style link the radius of motion is that of the inner circle. The radius of the outer circle is obtained by placing the hangers outside the wheels as shown. The motion of course will be slower in radius, and correspondingly easier. Fig. 4 shows the construction of the new spring-link. It consists of a cast-steel stirrup in which there is space for an inch spiral. A follower is placed on top of the spring and an I bolt is screwed into it. The I takes the end of the equalizer-bar which prevents the bolt unscrewing.

It is claimed that the danger of jumping the track on curves is practically eliminated, because the springs of the swinging links yield and prevent the blow which with the ordinary type of link comes with the full force when the bolster strikes the wheel-piece. The first trial of this type of truck was made on an electric railway 25 miles in length at an unusual speed for such service, and in spite of very narrow treads, shallow flanges and curves with 35-foot radius, it showed a splendid adherence to the rails.

Automatic Restarting Injector.

The restarting injector illustrated herewith was designed by William Sellers & Co., Incorporated, Philadelphia, Pa., for use on stationary and portable boilers, traction and hoisting engines, tug boats, etc.

It is made in a careful manner, is thoroughly automatic in every respect, and has been designed with a view to having as few parts as possible. There are no levers; no fittings except ordinary globe valves are required; it is very easily repaired, only a screw-driver and a monkey-wrench being required to take it apart when necessary to clean or renew parts. In designing this injector particular care has been exercised to obtain a wide range, to enable it to work hot water and to get maximum lift.



RESTARTING INJECTOR.

These injectors are made in 14 sizes, covering a range of horse-power from 2 to 400. Jenkins Bros., New York, are the sole selling agents for these devices.

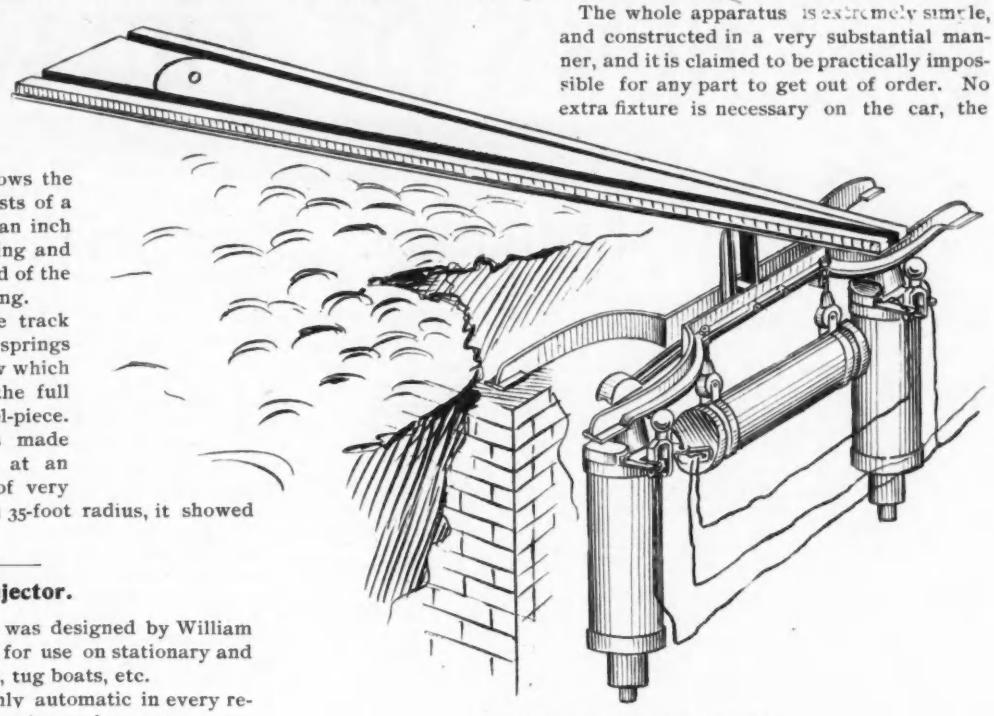
Automatic Electric Track Switch.

The Doty-MacKnight automatic electric track switch was exhibited to a few representatives of electrical journals and others interested, at the company's office, 54 Stone Street, New York, on the afternoon of July 8. This switch seems to be very effective in its action and is operated by the motorman on an approaching car.

The switch apparatus consists of a double solenoid motor and a current reversing switch all of which are contained in a box under the switch tongue, 18 x 36 inches in size. The electric current is applied by means of the regular controller through an insulated section of track near the switch terminal. On approaching the switch if the motorman sees that it is placed right for him he shuts off the current, allowing his car to skid over the insulated section. If, however, the switch tongue is not in the right position for the track he wishes to take, he leaves the current on, or if necessary, gives a little more current when the insulated section is reached and the switch is thereby instantly thrown in the direction required.

This switch it is claimed avoids the necessity of hiring men or boys to turn the switch tongues with bars or other implements. It operates very readily and positively, the force applied to the tongue being about 70 pounds. There are three parts to the mechanism, namely, two solenoids and a circuit switch. The function of the latter is to change the current from one solenoid to the other, as necessity requires. Each solenoid plunger acts upon a lever which moves the switch tongue; there being two levers, one on each aide, the tongue can be thrown from one side to the other, as occasion requires.

The whole apparatus is extremely simple, and constructed in a very substantial manner, and it is claimed to be practically impossible for any part to get out of order. No extra fixture is necessary on the car, the simple act of turning on or off the current while the car is on the insulated section being all that is necessary to operate the switch.

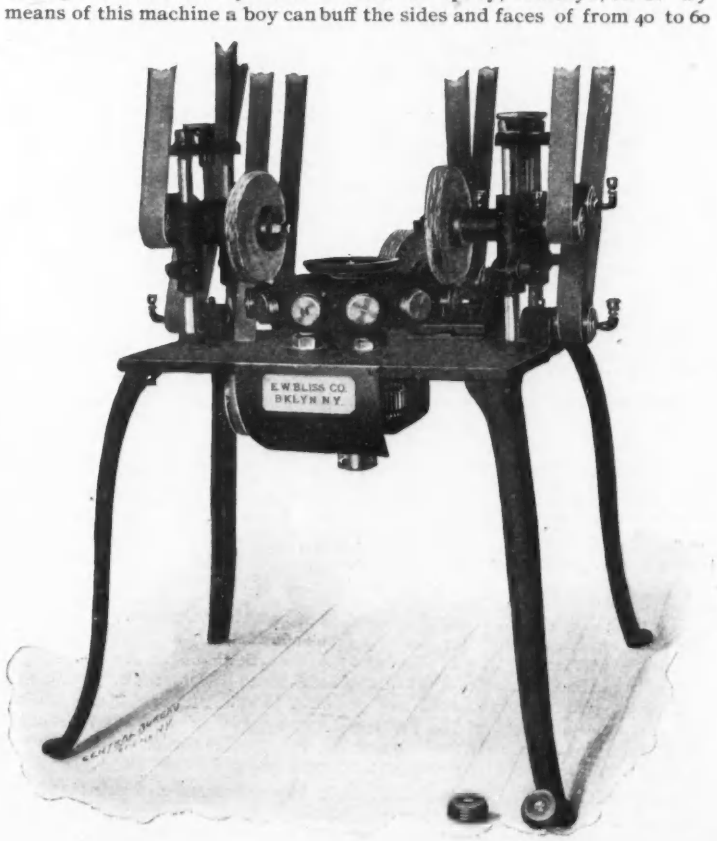


AUTOMATIC ELECTRIC SWITCH.

It is stated that this switch is looked upon with great favor by prominent electric railway managers.

Automatic Buffing Machine.

The accompanying illustration represents a new type of automatic buffing machine made by the E. W. Bliss Company, Brooklyn, N. Y. By means of this machine a boy can buff the sides and faces of from 40 to 60 incandescent light sockets per minute. The handling is reduced to a minimum, as the sockets are removed automatically after the buffing. The machine is equally well adapted to buffing screw-caps and similar goods. One set of chucks can be easily removed and another substituted.



BUFFING MACHINE.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, July 11, 1896.

THE MARKET IN GENERAL.—Electrical stocks of all classes were quiet during the week, the prices obtained being, in general, some fractions lower than the week previous. The reason for the dullness is probably of a political nature, general attention being distracted for the moment from business and given more closely to the work of a national convention in Chicago. A national political convention always diverts the attention of American citizens, and that during the past week was no exception.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	118¼	.
Edison Electric Ill., New York	100	95	97
" " " Brooklyn	100	99	102
" " " Boston	100	135	140
" " " Philadelphia	100	140	..
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	25¾	26¼
Electric Storage, pref	100	27½	29
General Electric	100	26⅝	26¾
General Electric, pref	100	71	73
Westinghouse Consolidated, com.	50	26¾	27½
" " pref	50	49½	51

BONDS.

Edison Electric Ill., New York	105	109	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	85	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	202½	203
American District Telegraph	100	29	39
American Telegraph & Cable	100	91½	..
Central & South American Telegraph	100	124	127
Commercial Cables	100	140	160
Erie Telephone	100	58	59
New England Telephone	100	92	..
Postal Telegraph-Cable	100	82	85
Western Union Telegraph	100	83⅜	83½

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17	17¼
Brooklyn Rapid Transit		21	21¾
Brooklyn Traction	100	..	14
" " pref.	100	46	48
Buffalo St. Ry	100	65	68
Cleveland Electric Ry	100	.	..
Columbus St. Ry	100	46	49
Hestonville	100	52	53½
" pref.		..	62½
New Orleans Traction	100	12	14
" " pref.	100	55	60
North Shore Traction	100	24	27
" " pref.	100	74	77
Rochester St. Ry	..	..	25
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	14½	14¾
West End, Boston	100	68	69
" " pref.	100	87	88
Worcester Traction	100	15	17
" " pref.	100	90	..

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	78½	80
Buffalo St. Ry. 1st con. 5s	100	104	*107
Cleveland Elec. Ry. 1st mtge 5s	100	100	*103
*Columbus St. Ry. 1st 5s	100	93	*97
Rochester St. Ry. 1st 5s	100	99½	*102
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTIONS.—The dullness in this class of securities that has prevailed for the past few weeks continues, the only stock showing any activity at all being Worcester preferred. The advance and the strength displayed are supposed to be due to the declaration of the regular semi-annual dividend of 3 per cent., and the 3 per cent. accrued, making 6 per cent. in all. The common stock did not share the strength of the preferred to any extent. Brooklyn Traction showed a slight decline on the dull market, and Buffalo Street Railway closed at a loss of three points from the preceding week.

ELECTRICAL LIST.—General Electric has recovered very little of the ground lost last week. Trading was about normal, and prices fluctuated within a narrow margin, the highest price of the week being 26⅝ and the lowest 24½, closing at the first given quotation. Westinghouse was a little weaker, the demand for the stock being somewhat dull. The bid prices for both common and preferred show a decline of a fraction as compared with last week's quotations.

TELEGRAPHS.—In common with the general tranquility Western Union held closely to the 83 mark during the week, closing at 83⅜. This, however, represents a gain of ⅞ over the closing since the previous week.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, July 13, 1896.

SUBWAY FRANCHISE.—The Board of Electrical Control has decided to transfer to the New York Telephone Company the subway franchise of the Metropolitan Telephone & Telegraph Company. This action was merely a matter of form.

INCREASED ITS CAPITAL STOCK.—The increase of the capital stock of the Metropolitan Street Railway Company from $16,300,000 to $30,000,000, which was certified by the Secretary of State during the past week, is for the purpose of taking up the stock of the various companies absorbed by the Metropolitan Company; to pay the cost of the improvements on the Lexington Avenue line, and to meet the contingent cost of changing the motive power on the Madison Avenue line. It is stated that $800,000 is also to be paid out of this for real estate.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., July 10, 1896.

MR. CYRUS ROBINSON, formerly manager and engineer of the Jeffrey Manufacturing Company, Columbus, O., on July 1 became general manager of the sales department of the J. H. McEwen Manufacturing Company.

THE WILLARD ELECTRIC & BATTERY COMPANY, which was recently organized in Cleveland, O., is making a storage battery which the company claims does not infringe other patents. The officers of the new company are Dr. E. N. Hawley, president; Charles Suhr, vice-president; H. M. Hawley, treasurer, and T. A. Willard, secretary and general manager.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., has been awarded the contract for two 40-kw and one 20-kw direct-connected multipolar generators, with panel switchboard, for the Ohio State Hospital at Columbus. The engine used in this plant will be made by the Buffalo Forge Works. Alexander Schulmann, of Cincinnati, secured the contract for the wiring of the plant.

THE JENNEY ELECTRIC MOTOR COMPANY, Indianapolis, Ind., reports the following recent shipments in addition to the usual run of smaller orders: one 50-kw multipolar generator with marble switchboard for Montpelier, Ind.; one 15-kw multipolar direct-connected dynamo, Louisville, Ky.; one 20-kw dynamo, Portland, Ore.; one 25-hp motor, Cleveland, O.; one 18-hp motor, New Albany, Ind.; one 20-ton electric crane outfit, Newcomerstown, O.; one 20-ton crane outfit, Montpelier, Ind.; one 25-hp motor, Peoria, Ill. The company has orders for 24 crane motors and controllers for Chattanooga, Tenn.; two 100-kw multipolar generators for Chattanooga, Tenn.; two 40-kw direct-connected multipolar generators and one 15-kw bipolar generator for "English Hotel," Indianapolis; two 25-hp multipolar motors for the Indianapolis *News*; one 40-kw direct-connected multipolar generator and one 80-kw direct connected multipolar generator and marble switchboard for Dayton, O.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, June 25, 1896.

NEGATIVE RESISTANCE.—A controversy has arisen from the interpretation that Messrs. Frith and Rodgers have placed on their recent researches on the alternate-current arc, they having asserted that a solid carbon arc has a negative resistance. This interpretation has been supported by Prof. Ayrton, while, on the other hand, Prof. Silvanus P. Thompson has brought forward a paper before the Physical Society, in which he has attempted to show that negative electrical resistance is an absurdity. Notwithstanding the attack thus made upon their position, Prof. Ayrton and the two experimenters I have mentioned stoutly defend the idea of a negative resistance, and claim that it is the only thing that will account for the peculiar behavior of the alternate current solid carbon arc. A long and exciting debate followed the reading of Prof. Thompson's paper, and the parties concerned seemed finally to agree to disagree.

NAVAL SIGNALLING.—Our naval authorities have been indefatigable of late in trying new systems of signalling, both for day and night purposes. Quite recently a trial was made at Portsmouth of a system invented by a Captain Sellner of the Austrian navy. This system consists of two lanterns, each capable of producing five classes of light; namely, fixed white and red, white occulting, red occulting and red and white occulting. The apparatus is worked from a pedestal about the size of an engine-room telegraph, a dynamo supplying the currents for the lights, while the occulting is produced by separate batteries. The objection to it is that the mechanism itself is far too deli-

cate and complicated, though the results obtained with it far exceed those possible with the present Morse flash signalling. There is a great diversity of opinion in the British navy as to the merits and demerits of colored lights, but a large number of our rising officers are strongly in their favor. As they point out, a signal on this system can be kept showing as long as required, while any amount of repetition of flash-signalling will not, under any atmospheric conditions, render it intelligible with any degree of certainty.

THE MANCHESTER MUNICIPAL ELECTRIC SUPPLY BUSINESS.—The report of the Electric Lighting Committee of the Manchester Corporation, for the year ending March 31 last, is probably one of the most successful that any electric lighting committee has as yet presented in this country. The capital expenditure of the Manchester Municipality on their electric lighting undertaking amounted to £250,000. On this capital outlay a net profit was made during the past year, after defraying all charges for cost of production, paying renewals, paying interest on loans, and providing the necessary sinking fund for the redemption of loans, of over £11,000, that is to say, a profit of about 4½ per cent. I may say that there was an unappropriated surplus last year of about £5,500, and the total net surplus of £16,500 made upon the two years' working has been allocated as follows: Nearly £7000 has been paid to the State fund in aid of the rates, £8500 has been added to the contingency fund, and £1000 has been carried forward to the next year. The supply at Manchester is at present on the five-wire system, and the number of customers amount to 1148. Extensions involving a capital outlay of nearly £100,000 are in contemplation, but these extensions will be on the three-wire system, with 200-volt lamps.

GAS COMMITTEES AND ELECTRIC LIGHT UNDERTAKINGS.—It is felt by many municipal electrical engineers in this country that electric light undertakings, when placed under the ægis of gas committees of gas-works owning town councils do not flourish as they should. As a matter of principle, there can be no doubt that it is best for a town council to confide the administration of two such dissimilar and often conflicting undertakings, such as a gas and an electric supply, in the hands of two totally separate committees, trusting to the spirit of emulation of the two committees, and to the wholesome fear of the ratepayer, to obtain for the two undertakings a maximum of progress with a minimum of expense. However, be the principle what it may, it must be said that, on the whole, gas committees in charge of electric light undertakings have in this country behaved very honorably to the "new illuminant." I only know of one instance in which the contrary can be distinctly proved. In this town, a large manufacturing one in the North, the electric light undertaking is obliged to buy coke fuel, which is quite unsuitable to the type of boiler adopted, at an extravagantly high price from the municipal gas works; customers are discouraged by high tariffs and high meter and transformer rentals, and the electrical undertaking is, generally speaking, suppressed as far as possible.

General News.

NEW INCORPORATIONS.

THE WHITMAN LIGHT & POWER COMPANY, Whitman, Mass., has been incorporated by Charles B. Davis, Charles N. Mason and Thomas Reed, with a capital stock of $25,000.

THE EAST McKEESPORT LIGHT COMPANY, East McKeesport, Pa., has been incorporated with a capital stock of $1,000. The incorporators are N. A. Means, McKeesport; John C. Devenny and W. D. Repper.

THE STANDARD INCANDESCENT LAMP COMPANY, Chicago, Ill., has been formed with a capital stock of $10,000. The incorporators are Alfred E. Manning, Charles M. McLaren and Josiah Gratty, 183 Madison Street.

THE F. P. JONES COMPANY, Buffalo, N. Y., has been organized for the purpose of manufacturing electrical apparatus. Those interested are F. P. Jones, Julius C. Sterns and Walter Cary, of Buffalo. Capital stock, $21,000.

THE MARYSVILLE & NEVADA POWER & WATER COMPANY, Smartsville, Cal., has been incorporated with a capital stock of $2,000,000. The promoters are John Spalding, Auburn, Cal.; James O'Brien, Jr.; Louis Courah, Smartsville, and D. P. Donahue, Marysville, Cal.

THE RED ROCK & SALMON CITY TELEPHONE COMPANY, Salmon City, Idaho, has been formed by Emerson Hill and H. C. Lewis, of Red Rock, and M. M. McPherson. Phil Shenon, G. G. Shaver, W. F. Boxwell, Jr., and E. J. Wilkinson, of Salmon City. Capital stock, $20,000.

THE PASSAIC & BERGEN MUTUAL TELEPHONE COMPANY, Passaic, N. J., has been incorporated by F. C. Van Dyke, James Simpson, James A. Morrisse, William B. Gourley, L. A. Piaget, A. A. Van Hovenberg, James F. Stewart, C. F. Van Riper and others. The capital stock of the company is $150,000.

TELEGRAPH AND TELEPHONE.

MONTEZUMA, IA—A telephone line is being built between this place and Deep River.

GALVA, ILL.—The Central Union Telephone Company will build an exchange in this place.

JACKSON, MICH.—D. A. Reynolds is seeking a franchise from this city to establish a telephone system.

BLOOMINGTON, ILL.—A new telephone line between Mechanicsburg and Lanesville is about to be opened.

BARABOO, WIS.—Arrangements have been completed to build a telephone line between Baraboo and Reedsburg.

COLCHESTER, ILL.—The Western Illinois Telephone Company has let the contract for a line between Rushville and Sugarton.

LOUISVILLE, KY.—The Home Telephone Company has petitioned for a franchise to establish a telephone system in this city.

MALDEN ROCK, WIS.—The Union Telephone Company is building a line from Plum City to Lund, Wis., a distance of eight miles.

MASON CITY, IA.—The telephone line to Manley, Kensett and Northwood has been completed and this place is now in connection with the rest of the State.

WAUSEON, O.—The Northwestern Telephone Company, of Defiance, it is reported, is about to build a line from Defiance to Toledo, *via* Napoleon and Wauseon.

BLOOMINGTON, ILL.—Three girls and two linemen struck work at the Home Telephone Company's exchange recently as a result of uncordiality between the girls and the head operator.

MADISON, WIS.—The Wisconsin Telephone Company will erect a new line between Madison and Janesville It will include Oregon, Stoughton, Edgarton and Indianford. Work will be commenced at once.

WAUKESHA, WIS.—The National Telephone Construction Company, which operated an exchange in this place, has ceased doing business. The original investment, it is stated, has proved a total loss.

MINNEAPOLIS, MINN.—The Northwestern Telephone Company will move its exchange to Myers Block, corner Fifth Street and Third Avenue, south. The work of remodeling the new quarters has been commenced.

OMAHA, NEB.—The Nebraska Telephone Company will probably build lines from York to a number of towns west of that place. The new line will be about 60 miles long and work will be commenced as soon as right of way can be secured.

MANKATO, MINN.—The City Council has granted a 15-year franchise to the North Central Telephone Company and the Blue Earth Valley Telephone Company. The rates of the former are limited to $24 and $18 per year for business houses and residences, and a telephone war is likely to ensue as the Northwestern Telephone Company already occupies the field.

THE CALLENDER TELEPHONE EXCHANGE COMPANY, Brantford, Canada, will shortly establish a United States factory for the production of its telephone apparatus. The company reports that it is now prepared to quote terms and make contracts for telephone service, and that its system it believes can be installed and maintained at a lower cost than existing systems.

TERRE HAUTE, IND.—The County Board of Tax Review has confirmed the assessors' assessment of the personal property of the Central Union and American Bell Telephone Companies at $5,000 each, but decided that his action in assessing the franchises of each company at $50,000 was illegal. The Board came to the conclusion, after examining the statutes, that the power to assess the franchises of telephone companies rested alone with the State Board of Tax Review.

ELECTRIC LIGHT AND POWER.

VICKSBURG, MICH.—The citizens have voted in favor of issuing electight bonds.

ROCKVILLE, MD.—The establishment of an electric-lighting plant in Rockville is contemplated.

FOSSTON, MINN.—The proposition to issue $10,000 water and light bonds was carried by a large majority.

GAFFNEY, S. C.—The Council is discussing the proposition to enlarge the lighting plant. Mr. L. Baker is clerk.

YARDLEY, PA.—The People's Electric Light & Power Company has secured the contract to light the streets of Morrisville.

MERCER, PA —An electric light plant in this place is assured, a company of business men of Mercer having been formed for the purpose.

OAKLAND, ILL.—A contract has been awarded for 19 2000-cp lamps, at $68 per annum per light, the same to burn all night every night in the year.

SENECA, ILL.—A representative of the Marcellus Land & Water Power Electric Company is seeking a franchise to light Seneca with electricity.

DORRANCETOWN, PA.—The Haddock Company will probably receive the contract to furnish electric light in this place at a cost of $85 per light per annum.

KEARNEY, N. J.—A committee of citizens has been appointed by the township committee to investigate the electric light service, which has been defective of late.

SOUTHINGTON, CONN.—A proposed increase in the price of electric lights is creating considerable opposition on the part of users, who threaten to have the lights taken out.

KINGSTON, N. C.—An election will be held in this place on August 3, on the question of issuing $8000 in 6 per cent. bonds to be used in the construction of an electric light plant.

GARRETT, IND.—The opening of the new water-works and electric plant in this city a few days ago was the occasion of public festivities of all kinds. It is stated that the plant is a very fine one.

BROOKLYN, N. Y.—The Bay Shore electric light plant at Bay Shore was sold at foreclosure sale on July 5 to the estate of H. B. Aldrich for $10,000, which covers the amount of mortgage and interest.

McLEANSBORO, ILL.—The City of McLeansboro will receive bids for the erection and establishment of an electric-lighting plant. Bids will be received at the City Clerk's office, Aug. 1. Mr. C. C. Wright is City Clerk.

MIDDLETOWN, N. Y.—A contract has been awarded to the Middletown Light & Power Company for 50 arc lights at $97.50 each per annum, and 200 incandescent lights at $15 each, to burn every night and all night.

TOPEKA, KAN.—At a special session of the Common Council, the report of Prof. Blake on the new electric light plant was accepted and the plant was formally taken over by the city and funds voted for the first payment thereon.

CRANFORD, N. J.—A contract has been authorized with the Suburban Electric Company, of Elizabeth, for the purpose of illuminating the streets of

this village. Incandescent lamps of 25-cp each will be used, and the cost will be $16 per annum per lamp.

MILWAUKEE, WIS.—Estimates as to the cost of putting in an electric light plant at the State Capitol have been made, the price being set at $13,000, while the annual cost of maintenance is placed at $600. A bill was passed by the last legislature providing for this plant.

DARLINGTON, WIS.—Parties from McGregor, Ia., have bought up the water power at this place, formerly owned by Dexter & Co., and if the City Council will grant the privilege of putting up poles in the streets, they will put in an electric light plant immediately.

MONTROSE, PA.—The Susquehanna Electric light, Heat & Power Company will issue $20,000 in coupon bonds in amounts of $100 each, payable $1000 annually, with interest at 6 per cent., payable semi-annually. The company has advertised for sealed bids for the bonds.

ASBURY PARK, N. J.—Thomas Grimwood, the old lessee of the Neptune Electric Company of this place, which failed some time ago, has brought suit to recover $6000, the alleged value of the machinery placed in the plant during his term of lease. A counter-suit is pending against Grimwood for $3500 for unpaid rent.

WESTERLY, R. I.—It is proposed to hold an election for the purpose of deciding the municipal electric light plant question. This decision which was made at the last meeting of the Board of Aldermen will have to be concurred in by the Common Council before the question can be submitted to the voters at the next municipal election.

The Electric Railway.

YARMOUTH, ME.—It is reported that the electric railway to Yarmouth will be built in the near future.

PENN YAN, N. Y.—The old project of the extension of the Prattsburg & Kanona Railway is again being agitated.

CHICAGO, ILL.—It is likely that the North Chicago Electric Railway Company will be granted the franchise asked for.

PITTSBURG, PA.—The Allegheny Traction Company is seeking permission to double track its lines on some of the streets in Millvale borough.

WATCH HILL, R. I.—It is proposed to commence work on the construction of the Sea View electric railway to Narragansett Pier at an early date.

JAMESTOWN, N. Y.—In order to complete the work on the Jamestown & Lake Erie Railway, operations are being carried on at night by the aid of arc lights.

MADISON, WIS.—The Madison Electric Street Car Company has decided to extend its line to Forest Hill Cemetery one and a half miles west of the city's limit.

SPRINGFIELD, MASS.—The stockholders of the street railway company met and authorized the directors to petition the City Council for a location on Dwight street.

HARTFORD, CONN.—The Street Railway Company's track on Central Row was torn up and will be replaced by new rails. Work similar to that will be done on other streets.

SPRINGFIELD, MASS.—The construction of the electric road from Springfield to Charlestown, N. H., will be commenced within two weeks. The estimated cost of the road is $175,000.

PLATTSBURG, N. Y.—A new railway company has been formed under the name of the Lake Champlain Extension Company. President, Ned Baker; vice-president and general manager, L. Burritt.

DOYLESTOWN, PA.—It is stated that the Doylestown & Willow Grove Electric Railway Company has purchased a tract of five acres of land along the Little Misheminy, upon which it will build a power-house.

SOUTH SWANSEA, MASS.—The County Commissioners have decided to build the proposed highway from Pearsall's Road, South Swansea, to the State line, in the direction of Warren, to meet a new road from that town.

OLEAN, N. Y.—There is talk both in Olean and Bradford, Pa., of connecting the two cities by an electric railway. Whether or not the plan goes through, it is reported to be a certainty that the Olean Street Railway will be extended to Rock City.

HAMBURG, N. Y.—A meeting was held at Kopp's Opera House, for the purpose of considering the proposition to build a trolley road from Hamburg to Buffalo. Amos H. Baker, of Hamburg, D. F. Callahan, of Buffalo, and others, are interested.

BAYSIDE, L. I.—The residents of this place desire to have the Steinway Electric Railroad Company extend its line to Bayside. The distance is about seven miles. It is proposed to parallel the Long Island Railroad Company's branch between the two places.

NEW YORK, N. Y.—The Metropolitan Street Railway Company has filed with the Secretary of State a certificate of an increase in its capital stock from $16,500,000 to $30,000,000. This certificate states that the debts and liabilities of the company aggregate $15,000,000.

PITTSBURG, PA.—The Consolidated Traction Company will soon change the Fifth and Penn Avenue cable lines to the trolley system. The company has already laid about 50 miles of steel rails and 25 miles of copper trolley wire, and the work will probably be completed by September.

HOBOKEN, N. J.—On the night of July 3 a number of property owners tried to prevent the Jersey City, Hoboken & Rutherford Electric Railway Company from laying its rails in Second Street, despite the orders of the Supreme Court. Police protection was called for, and on the arrival of the officers quiet was restored with some difficulty.

CAMDEN, N. J.—The residents of the northwestern portion of Camden are circulating a petition asking the Camden Horse Railway Company to extend the tracks on North Second and Third Streets, from State to Erie Streets. The company already has the consent of the property owners, and the City Council has given it permission to operate the road.

MILWAUKEE, WIS.—A franchise has been granted to the Milwaukee & Waukesha Street Railway Company for the construction of a line between the two cities. The Waukesha authorities have already granted a franchise in that place. The construction will be begun immediately, and bonds to the amount of $1,000,000 are to be issued under the trusteeship of the Illinois Trust and Savings Bank.

FALL RIVER, MASS.—An order was introduced into the City Council recently to revoke the grant to the Globe Street Railway Company of the layout to and upon Slade's ferry bridge. It is claimed that the railway company is not keeping its agreement to sell six tickets for 25 cents, as it does not put these tickets where the majority of the traveling public can purchase them. The order was carried over until the next meeting.

HACKENSACK, N. J.—Several gentlemen have been engaged in securing signatures to a petition to the Hackensack Commission to authorize the construction of a trolley line through Main Street. The company seeking the right of way is known as the Union Traction Company. The local representatives are D. A. Pell and Samuel Taylor. It is the intention of the company to construct a line from Fairmount through Hackensack, thence to Hasbrouck Heights, Carlstadt, East Rutherford and Arlington, where it will connect with the consolidated lines to Newark.

NEW YORK, N. Y.—Argument was heard in the Supreme Court on July 6, before Justice Lawrence, on the application for an injunction against the Comptroller to restrain him from continuing the sale of the franchise for the railways to be built in the annexed district from the Bronx to the Harlem River, over which there has already been considerable litigation. It is claimed that under the law there can be no higher bid than 100 per cent. of the gross receipts. The People's Traction Company at the former auction sale bid 6975 per cent. of the gross receipts. The company now wants the court to award it the franchise on its 100 per cent. bid, while the other competing roads want the matter to be adjudicated, pending the injunction. Justice Lawrence reserved decision.

Personal Notes.

MR. JAMES PASS, of the firm of Pass & Seymour, Syracuse, N. Y., sailed for Europe on the steamer *St. Louis*, July 15. Mr. Pass will visit England and the Continent, and most of the points of interest. This trip will be one of pleasure.

MR. KEMPSTER B. MILLER has been appointed electrician of the Western Telephone Construction Company, Chicago. Mr. Miller was formerly in charge of the telephone department of the United States Patent Office, and is regarded as being one of the best informed persons in telephone art in this country.

MESSRS. WINTHROP THAYER, RODNEY THAYER AND W. C. TURNER, who for several years were connected with the Babcock & Wilcox Company, New York, have resigned their positions with that company to go with the Aultman & Taylor Machinery Company, Mansfield, O. Mr. Frank A. Thayer, who was general manager of the Goubert Manufacturing Company, New York, for several years, has severed his connection with that firm and also taken a position with the Aultman Company.

Trade and Industrial Notes.

"FACTS WORTH CONSIDERING" is the title of a pamphlet just issued by the Royal Electric Company, Peoria, Ill. The facts set forth are extremely favorable to the Royal Electric Company's apparatus.

A FEW SPECIALTIES.—The Law Battery Company, Cranford, N. J., has issued a sheet illustrating some of its specialties. They include batteries of various descriptions and electro-medical and cauterizing apparatus.

BATES-CORLISS ENGINES.—The Bates Machine Company, Joliet, Ill., has just issued a catalogue of its engines and power transmitting machinery. The catalogue is well illustrated and gives dimensions of the various machines manufactured by the company.

THE ELECTRIC APPLIANCE COMPANY report that its Armorite interior conduit is meeting with a rapid sale. The great advantage in being able to bend the conduit, and thus avoid the use of regular and special elbows, is very much appreciated by the trade.

THE C. B. ATTACHMENT COMPANY, manufacturers of boiler attachments for the prevention of the formation of scale in boilers, New York City, has recently received orders from the following named concerns: Williams & Clark Fertilizing Company, Cartaret, N. J., attachment for 100-hp boiler Gillis & Geoghegan, New York City; Excelsior Steam Power Company. The company has also shipped these attachments to Anniston, Ala.

INDUCTION COILS WITH ADJUSTABLE CONDENSERS.—Mr. James C. Biddle, Drexel Building, Philadelphia, is meeting with marked success in introducing the new Willyoung induction coils with adjustable condensers. This apparatus is built upon correct, improved, scientific lines, and is fully equal in grade of workmanship and efficiency of results to the best types which have been made heretofore only in England and France. When properly handled each coil is guaranteed to produce a continuous discharge of the rated spark length without breakdown or other injury. Messrs. Willyoung & Co. make a specialty of constructing coils of large size, and are also prepared to fill orders quite promptly.

Business Notices.

The illustrations in this issue were made by the Photo-Engraving Company, 67–71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.